IMPROVISING SCIENCE TEACHING KITS FOR SCHOOLS

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Foreword

OURS is a poor country with extremely limited resources for school education In the context of modern developments, the teaching of science at all levels of school education is a must. It is through science that we can find a proper cure for obscurantism, superstition and other wild beliefs. The children of today will be the citizens of tomorrow. They have to be shaped to become amenable to reason and prevented from being carried away by emotional and other forms of expression Besides, the world of the twenty-first century will be much more technological than the world of today. For living a useful life in such a society, a sound base of science is necessary.

Science does not consist of facts and memorising of facts. It is through a process of discovery which science provides that a person develops his reasoning and judgment. But, the discovery approach for science cannot be adopted without experimentation. Experiments require tools, gadgets and apparatus. All these cannot be purchased without incurring heavy expenditure Therefore, only way out is for the teachers and all concerned to improvise science teaching kits How to proceed in this direction is really the basic question. All my colleagues in the Department of Science Education have applied their minds to this task. Dr. M.C. Pant can justly claim leadership Mr. B K Sharma and Dr. Bukhalov have spent hours to find solution to many ticklish problems. They are both extremely technical in the fullest sense of the term. This book provides valuable information and guidance for improvising science teaching kits. Mr. B.K. Sharma and Dr. Bukhalov deserve the warmest congratulations for preparing this book.

It is to be expected that there would be some limitations in a book of this type. Therefore, all readers are earnestly requested to send their comments, criticism and suggestions. They will be gratefully acknowledged and made full use of in bringing out a subsequent edition.

S.V.C. AIYA
Director, NCERT

New Delhi-16
18.8.1972

Acknowledgement

THE brochure owes its existence to the inspiring leadership of Dr. M.C Pant, Head of the Department of Science Education, NCERT. He provided necessary guidance to the development of prototypes, suggested alternatives and patiently watched the try-outs. Having covered the primary and middle stages, he motivated preparation of this brochure for the use of the various agencies implementing the Project as well as for the foreign guests who frequently visit the Department and wish to know about the activities and plans of the Department in a short time He took personal interest in scrutinizing the draft of the manuscript and also edited it

The authors are very grateful to Prof. S.V C Aiya, Director, NCERT, who despite his busy schedule spared his precious time to go through the manuscript. The brochure would have been incomplete but for his valuable suggestions and ideas included afterwards.

We also appreciate the co-operation extended by the subject specialists, both UNESCO and Indian, working in the Department of Science Education in scrutinizing the draft of the manuscript relating to a particular kit. For the Primary Science Kit, the authors are particularly grateful to Dr. B.D. Atreya who spent quite sometime on this. In the area of Physics, Dr. M.F. Kolpakov, UNESCO Consultant, Prof. B. Sharan, Prof. J. K. Khurana and Prof. Chhotan Singh provided the necessary expertise. In the area of Chemistry, this was done by Dr. L.V. Levchuk, UNESCO Consultant and Prof. N.K. Sanyal and in Biology by Dr. V.I. Galakhov, UNESCO Consultant and Prof. S. Doraiswami of the Department of Science Education.

We are grateful to our colleagues, including the workmen of the Central Science Workshop for their timely assistance required in the preparation of this publication. We appreciate the fine work done by Shri G.K. Virmani of the Department of Teaching Aids in preparing photographs for this brochure.

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AUTHORS

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1. Introduction

In the age of fast-developing technology, it has become necessary for all countries, especially the developing ones, to reorganise and improve the teaching of science throughout the school stage, especially because it is through science that we get the fundamental base to develop technology and use it for the betterment of mankind. The present-day children are far more informed than their fathers and fore-fathers at their age not on account of some special training but mainly on account of their enriched man-made environment The recent developments in the use of electricity and electronics are no longer a wonder as they used to be fifty years back. Battery-operated transistorised radios have reached the far-flung areas of the country. Even the tiniest and the remotest village will have a few such sets, if not more.

Although the child takes such innovations as a matter of fact, yet his curiosity regrading the working of such wonderful gadgets is fully aroused. Naturally, he wants to know how and why they function. He is anxious to learn about the world he lives in. He wishes to make things with his own hands, and finally he wants to establish his own logic about the basic laws of science.

The need for improving the educational system in the country was felt and several efforts were made to improve the teaching of science in the post-independence era. The problem was immense, the expenditure involved was too much and the existing physical facilities in schools were almost negligible Yet, there was a need for a centralised effort.

In early sixties, the matter was taken up by NCERT in all seriousness. A department of science education was set up to make such an effort. This Department surveyed the existing patterns in the various States and planned a project which is financed by the Ministry of Education, the UNESCO and the UNICEF. New books were written, teacher guides and laboratory manuals were prepared and the responsibility of improvising laboratory equipment was given to the Central Science Workshop.

The main emphasis of the Project is on *learning science by doing*, which gives a key-role to the improvised apparatus. So far, laboratory apparatus has been improvised up to the middle school level. The work on secondary level will be taken in hand from next year. This apparatus, made of indigenous material, is contained in a box, which facilitates its movement from one classroom to another. Many of the items are available even in small towns and others could be made in ordinary engineering workshops. The apparatus, popularly known as science kits, are of two categories, (i) for demonstration, and (ii) for pupil's experiments. Every effort was made to reduce the cost to the barest minimum so that these kits could be within the reach of every school. The total cost of complete laboratory for elementary and middle school consisting of 10 kits may be about Rs. 2000 only.

Further details of these kits are given in this brochure.

2. Educational Pattern

THE educational pattern in India is a complex one and the complexities are so great that anything which succeeds in India can be looked upon as something which would succeed elsewhere.

There are 21 States and 8 Union Territories in the country and each of them is free to take its own decisions on not only the pattern of education but also on all problems connected with it. Education is financed by State Governments. There are about 5,00,000 primary schools, about 1,00,000 middle schools and over 30,000 secondary schools. Over 75 per cent of the primary and middle schools are in rural areas. About 40 per cent of the primary schools are single-teacher schools. There are 15 Indian lauguages recognised in the Constitution of India. In addition to these English and about 42 dialects are used as media of instruction. The medium of Instruction in the secondary stage is ordinarily one of the languages included in the Constitution of India or English.

The School System

The pattern of school system is not exactly the same in all the States and Union Territories. There are variations but they are not very large. Hence, it is possible to attempt a rough generalisation.

In some States school education is spread over ten years and in others eleven years. Thus, there are two patterns in general, depending upon the number of years for school education. They consist of three school stages—Primary or Elementary during the first four or five years, Middle or Junior High during the next three years and High or Secondary School in next two or three years. Primary School, therefore, has either Classes I to IV or I to V Middle school caters either for Classes I to VII or for Classes I to VIII. A high or secondary school has either Class V to X or Classes VI to X (XI). There are also some secondary schools having only Classes VIII to X or IX to XI. Besides there are special schools and public schools.

The responsibility of framing curriculum up to the middle school stage is that of the State Governments or of the Union Territory Administration. They also arrange final examinations at each of the two stages In the case of secondary schools, these aspects are looked after by the Boards of Secondary Education of the States.

Teacher Education

A teacher for elementary and middle school is trained in institutions known as Primary Teacher Training Schools. These institutions usually admit boys and girls who have successfully passed the examinations for Secondary School Leaving Certificates (SSLC)). Until recently, the course of teacher education was of one year's duration. Now it has become, or is fast becoming, a two-year course in most of the states.

Teachers for secondary schools are educated in the Teacher Training Colleges or

Colleges of Education. They admit university graduates. Duration of this course is of one year, which leads to B. Ed. degree after successful completion of the course.

Nowadays trained teachers with first degree in Arts or Science and B. Ed. are also employed to teach the middle school classes in high schools having middle sections or some large independent middle schools. For higher secondary classes a teacher must possess a master's degree as well

3. Present Position of Science in the School Curriculum and Attempts made so far for its Improvement

SCIENCE in some form or other is taught right from Class I in all the states of the Indian Union. In Classes I-V, it is taught under different names as elementary science nature study, general science or health, hygiene and physiology. In Classes VI-VIII it is mostly taught as general science or everyday science The subject is more or less a compulsory one for all the students up to Class VIII, though there are some exceptions. At the high school or higher secondary stage, different practices are followed in different States. In some States the subject is taught to all the students as compulsory general science and also as elective science disciplines to those who want to offer these as optional subjects.

In some States Science is taught as optional science disciplines only, and no compulsory general science is taught at this stage, while in others it is taught as compulsory general science for all the students

In Classes I-VIII the science teaching is not accompanied with regular individual laboratory work. At the higher secondary stage, most of the States provide for an individual laboratory programme where science is taught as an elective science. In a couple of States there is no provision for individual laboratory experiences to the children even at the secondary stage

Although much emphasis is put on providing science education at school, the traditional lecture method of teaching science is mostly in use There are no laboratories, no demonstrations and no experiments by students in the primary and middle schools. Even the teachers are not properly trained for this task This results in great difficulties in developing the desired scientific attitudes in the pupils. The teacher just explains the basic laws of science and tries to give examples. Students are only silent participants in this process. They never get an opportunity to verify teacher's assertions by doing some experiments or to inquire into or investigate the various scientific phenomena. The idea that children, suitably encouraged, can form their own hypotheses, test them by observation and so discover some nature's laws for themselves, has been almost alien to teachers. Students who choose science as an elective subject at secondary stage may have laboratory facilities but others never get an opportunity to do experiments

The existing curricula in the teacher training institutions do not include science content. Usually in either of the two types of institutions there is only one science teacher for teaching the 'general methods of teaching science'. Since there are no labora-

tories, teaching aspect remains more or less theoretical. A teacher thus educated will be poorly equipped with competencies required for the job.

During the Second and the Third Five Year Plan periods, a number of schemes were taken up for the improvement of science education at the school stage. The efforts were mainly directed towards improving the provision of elective science courses in the higher secondary schools, revision of the syllabi, strengthening of the laboratory and library facilities and short-term in-service courses for teachers through summer institutes. The establishment of the National Council of Educational Research and Training and a separate Department of Science Education within this body with a view to providing leadership and organising new programmes of science education is another major step in the total programme of improving science education. The establishment of four Regional Colleges of Education, where a special programme of four-year training in content-cum-pedagogy is organised for science teachers of secondary schools, it is hoped, will establish new standards of training of science teachers and help in solving the problem of the shortage of science teachers to some extent.

The various efforts made up to the end of the Third Plan period were continued with more inputs during the Fourth Five Year Plan period. Some new important features were the establishment of 20 study groups in various universities and research institutes for developing new curricular materials in science and mathematics for the school stage.

The main effort from the central level was directed towards providing assistance to the States to try out new curricular materials in selected schools under a pilot project assisted by UNICEF. This would enable the States to develop their own versions of new courses in the regional language after a scientific try-out.

4. The Project

WITH a view to reorganising and expanding the teaching of science for as many students as possible throughout the school stage in order to develop the scientific attitude and scientific literacy in the students, a project, popularly known as UNICEF aided Project has been launched. The UNESCO had already provided assistance in the shape of equipment for laboratories and workshop, foreign expertise and training facilities abroad for Indian counterparts under the Secondary Science Teaching Project for developing an up-to-date and upgraded curriculum in science and mathematics for the secondary stage.

As indicated earlier, each State was required to select 50 primary and 30 middle schools for the try-out of the curriculum material and science kits developed. For this purpose full assistance was provided by the Government of India and the UNICEF to the states for translating the materials, for the training of the teachers and for the supply of NCERT kits. Besides this, selected key institutions like the State Institute of Science Education, State Institutes of Education, Teacher Training Colleges and Teacher Training Schools were also equipped with complete set of science laboratory-equipment to enable them to play their role in training and supervising teachers involved in trying out the new curricula in Pilot Project schools and also to strengthen pre-service training of teachers.

Since then, it has been decided to enlarge the pilot phase to a phased wider introduction of new curricular materials. Under this, 24,000 primary and 31,000 middle school kits developed by NCERT are to be supplied by the UNICEF to various States/ Union Territories This would cover about 5 per cent of the total primary and 35 per cent of the total middle schools. Production of such a large number of kits will give a boost to the industry and bring down the price level.

5. Science Kits

THE main objective of the project is to upgrade and update the teaching of science throughout the school stage and to ensure the active participation of the students in the teaching-learning process by providing first-hand science experiences. This is to be achieved by involving children in doing experiments and discovering the various facts, laws and generalisations for themselves The teacher provides motivation and necessary guidance. In order to implement this new methodology in actual classroom, suitable apparatus has been improvised using indigenous materials and has been collected and organised in the form of 'Science Kit' These kits are portable and act as mini-laboratories, suitable for use even in an ordinary rural school without the facilities of separate science rooms or conventional laboratories. The cost has been reduced to the minimum, utilising most of the items which are readily available in the local markets. Items are simple in operation and sturdy in construction so that the children can use them without any fear of damage. These kits provide the following additional advantages :

(i) Availability of necessary items at one place.
(ii) Multipurpose use of items.
(iii) Economy of time in setting up.
(iv) Economy of consumable materials.
(v) Portability from one room to another.
(vi) Provision for teacher's innovation.
(vii) Low cost and use of indigenous resources.
(viii) Easy replacements of lost or broken items

The kit guides have been prepared which contain a list of the items, their sketches and detailed description. This facilitates the replacement of any part that is rendered unserviceable in use. Some of the experiments are also illustrated.

The kits are of two types. One category of the kits is meant for the classroom demonstration by teachers and the other for pupil's experiments. Some kits serve both the purposes by the addition of a few sets of items available in the local market, depending upon the size of the class. The demonstration kits have been designed for a class of 35-40 students. Items meant essentially for demonstration purposes are of large size so that a child at a distance of 6-8 metre can also see the details. Similarly, a 'Pupil's Kit' can serve a class of 35-40 students. They also contain consumable materials like chemicals etc. for a year's use except those chemicals which are to be handled with utmost care or can be procured more easily locally.

The kits developed so far cover the primary and middle (Junior High School) stages of the secondary schools. At the primary stage, whatever may be the syllabus, the kit will be quite useful as it will cover most of the topics. At the middle stage the kits are quite adequate to cover physics, chemistry

and biology as the General Science even up to Class X. Hence the kits developed would adequately cover the laboratory needs of the first ten years of schooling Further, although special curriculum has been developed from Class I to XI and based on this, books have been written, but a book prepared for Class VI can be used for Class VII also, if so required. It is, therefore, suggested that all the kits for physics for various classes taken together should be looked upon as a combination useful to teach physics.

The process of development of the kits is also interesting. It is the outcome of the sustained and laborious efforts of a team of subject specialists, engineers, materials experts costing advisers and market surveyors Ideas were originated by the subject experts, both UNESCO Consultants and Indian counterparts. They also provided necessary information regarding the availability of some type of apparatus in the market for this purpose. If available, this was purchased and examined by engineers (both UNESCO and Indian counterparts) for quality, cost, suitability, availability (whether imported or indigenous) etc. When it satisfied the manifold requirements, it was included in the kit, like a small magnetic compass at a cost of one rupee or student's microscope at the cost of Rs 10/- developed by an Indian firm. In most of the cases, however, the apparatus was to be improvised to suit the requirements of the new curricula and methodology of teaching science The team held discussions and the requirements were studied. As a result a prototype was developed. This was tried out in the laboratories of the Department. Results of close observations were conveyed to the prototype developing team. Modifications found necessary were made and the prototype was tried in a real school situation Reactions of the pupils and teachers were noted and further modifications made, if necessary. Thus the prototype was born.

This prototype was then passed on to the Design Office for making detailed drawings. It was at this stage that the prototype underwent slight modifications from the point of view of interchangeability of its parts and process planning Blue prints then rolled out of the section and along with the prototype found their places in the Inspection and Quality Control Section This section laid down standard specifications, schedule of inspection and suggestions for further improvements.

6. Details of Kits Developed so far

A List of the kits developed so far is given below. A complete set provides the entire laboratory equipment for primary and middle schools There are ten kits including four for pupil's experiments. The total cost of all these kits is presently around Rs. 2000 but it could be reduced substantially by commercial exploitation on mass scale.

D.S.E. (C.S.W) I	Primary Science Kit (complete laboratory for primary schools.)
D S.E (C S.W.) II	Physics Demonstration Kit No. I
D.S E (C S.W) III	Physics Pupil's Kit No I
D S E. (C S.W.) IV	Physics Demonstration Kit No II
D S.E (C.S W) V	Physics Pupil's Kit No. II
D.S.E (C S.W.) VI	Biology Demonstration Kit for middle stage
D S.E. (C.S W.) VII	Chemistry Demonstration Kit for middle stage
D S.E. (C.S.W.) VIII	Chemistry Pupil's Kit for middle stage
D S.E. (C.S.W) IX	Physics Demonstration Kit No. III
D.S.E. (C.S.W.) X	Physics Pupil's Kit No III

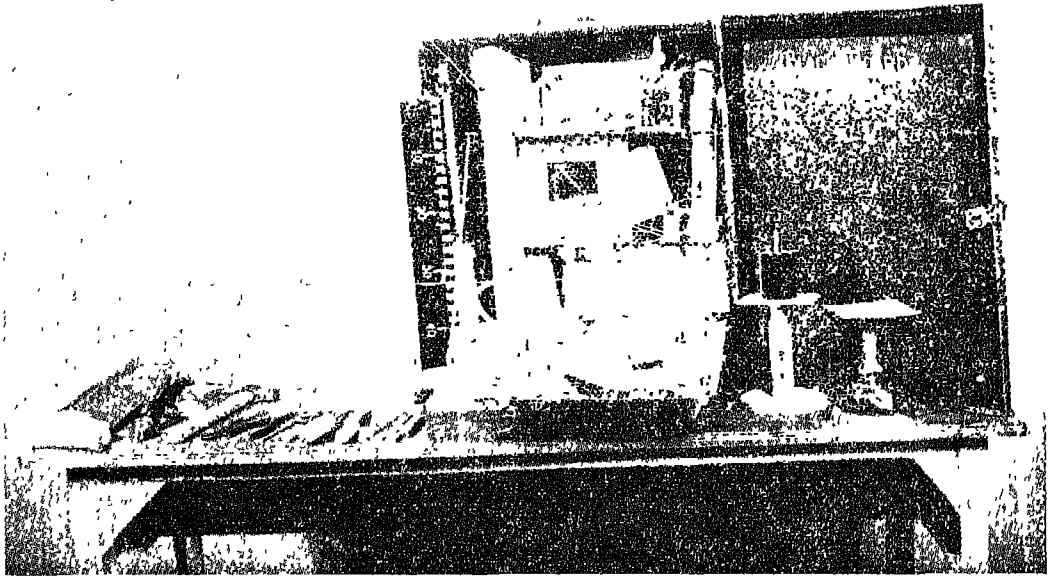
(Kits Nos. II to X cover the entire new science curriculum proposed for the middle school stage. These kits can very profitably be used even to cover the existing SSLC/Matriculation courses in science prescribed in most of the States)

Earlier, another kit, known as Biology Demonstration Kit No I, was also developed for the first year of middle stage. Ultimately, this has become a part of C.S.W. Kit No. VI.

A brief description and salient features of each of the kits are given in the following pages.

PRIMARY SCIENCE KIT

D.S.E. (C.S.W) 1



This provides a complete portable laboratory for all the 4 or 5 years of the primary stage. With the addition of a number of items which are locally available, about 40 children can perform their experiments in groups or sometimes individually. Built in the kit box are collapsible demonstration table and a chalk board which make it a self-contained laboratory. The teacher can use it in the classroom as well as in the open, either in the shade of a tree in summer or in sunshine in winter. The kit has a special compartment for hand tools and all essential hand tools have been provided so that the teacher can prepare his own improvised equipment or undertake minor repairs to the kit apparatus if so required. There is also a special compartment for a set of instructional charts in the kit box.

With the dimensions of the kit box as 450 × 125 mm and 600 mm height it eliminates all storage problems. It can be placed inside a cupboard or in the corner of a room. If carefully packed, it could be kept in any position. A kit guide is supplied along with the kit. This contains a list of the general items, hand tools, consumable materials, chemicals and set of instructional charts. Sketches, brief description and uses of the items have been provided and a few experiments illustrated. Wherever found necessary, details of the parts of

assemblies have been given.

Reference Books Published (NCERT)

(*a*) *Textbooks*

(*i*) Science is Doing for Class III
(*ii*) Science is Doing for Class IV
(*iii*) Science is Doing for Class V

(*b*) *Teacher's Guides*

(*i*) Teachers Guide to Science is Doing for Class III
(*ii*) Teachers Guide to Science is Doing for Class IV
(*iii*) Teachers Guide to Science is Doing for Class V

(*c*) *Teacher's Handbooks of Activities*

(*i*) General Science—A Handbook of Activities for Primary Schools, Vol 1.
(*ii*) General Science—A Handbook of Activities for Primary Schools, Vol. 2.
(*iii*) General Science—A Handbook of Activities for Primary Schools, Vol 3

(*d*) *Kit Guide*

Scientific Topics covered under New Curriculum

1 Our Universe
2. Air, Water and Weather
3. Rocks, Soils and Minerals
4 Forces and Work
5 Matter and Materials
6 Housing and Clothing
7 Living Things
8 Plant Life
9. Animal Life, including a separate chapter on Birds in Class III
10 Man and His World (In Class V only)
11. Human Body Health and Hygiene

List of the Kit Contents

I GENERAL ITEMS

1. Aluminium *katori* (a cup without handle) 100 mm dia —2
2. Balls (rubber) 80 mm. and 50 mm. dia.—1 each
3. Beaker 250 ml and 100 ml.—1 each
4 Hard glass test tube—1
5. Compass needle—1
6 Electric circuit-board with battery, bulb and switch—1
7. Enamelled copper wire 24 gauge—2 metres
8 Football pump—1
9 Glass marbles—50
10 Glass jar or empty jam bottle—1
11 Glass rod 15 mm dia. ×150 mm long—1
12 Hand fan—1
13 Hand lens (mag 4×) with plastic frame—1
14 Hard board 200×200×3 mm with rectangular slot of 80×80 mm in centre—1
15. Hollow polythelene rectangular containers of same capacity but different sizes—1 each
(*a*) 120×60×30 mm height (red)
(*b*) 90×30×80 mm height (blue)
16 Kitchen strainer (wire-net) —1
17 Magnet bar—1 pair
18 Measuring cylinder 100 ml —1
19 Aluminium tube 60 mm dia.×125 mm long—3
20. Soft iron nails 6 mm dia ×130 mm long—2
21 Mounting needles—2
22. Plane mirror mounted on wooden base 100 mm. ×60 mm —1
23 Plastic comb —1
24 Plastic funnel 75 mm dia —1
25 Tubing 7 5 mm dia. (Polythene)—1 metre
26 Plastic tumbler 100 mm high —2
27 Plastic syringe—1
28 Polythene bags assorted —6
29 Pulley— 1
30 Rubber stoppers assorted for item No 4—2
31. Rubber stoppers assorted for item No 36—3
32. Scale half-metre with five holes—1
33 Sieve 125 mm dia.—1
34 Lamp (kerosene)—1
35 Spring balance 1 kg —1
36 Test Tubes 15 mm dia ×125 mm long—6
37. Theromometer 0—110 C on wooden base—1
38. Thermometer clinical—1
39 Torch with 2 cells—1
40. Tripod stand with wire gauze—1 each
41 Water wheel—1
42 Wedge—1
43 Wind-van—1
44 1 kg. weight—1
45 M.S. Wire 3 mm dia. 200 mm long—1
46. Glider—1
47. Top pan spring blance 2 kg.—1
48. Model of Lift pump—1
49. Toy electric motor—1
50. Kit Box

II HAND TOOLS

1 File triangular (100 mm)—1
2. Hammer with claw (250 gms)—1
3. Hand Drill (6 mm. dia. capacity) with drill bits —1

4 Knife with wooden handle (blade 100 mm long) —1
5 Pliers (150 mm)—1
6 Tennon saw (blade 250 mm long)—1
7. Tin cutter, straight—1
8 Screw driver, 100 mm —1

III CONSUMABLE MATERIALS

1 Filter paper—2 sheets
2 Candle (medium)—1 packet
3. Card board—1 sheet
4 Cotton thread—1 ball
5 Cellophane sheets—30 cm sq
6 Iron nails assorted—1 packet
7 Drawing pins—1 packet
8 Plasticine—50 gms
9 Rubber balloons assorted—1 dozen
10. Rubber bands—1 packet
11 Sand paper—1 sheet
12 Sealing wax—2 sticks
13 Straws—1 dozen
14 Steel Wire (24 S W G)—11 metre

IV CHEMICALS

A Containers for chemicals
(1) Plastic phials—6
(2) Plastic dropping bottles —2
(3) Plastic container of 2 oz capacity—2

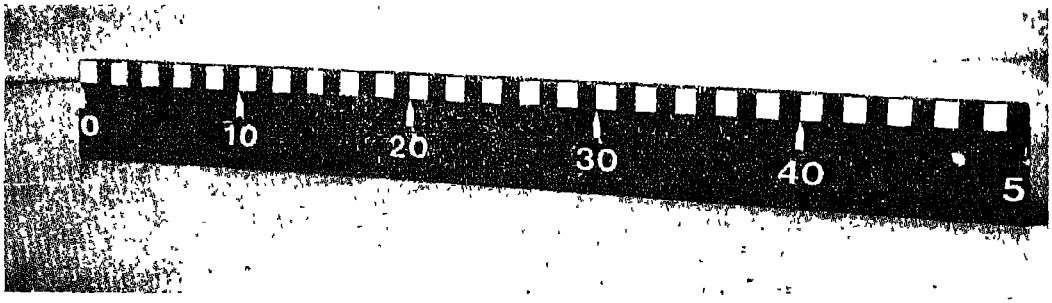
B Chemicals to be arranged locally
(1) Ammonium phoshate—50 gms.
(2) Ammonium sulphate—250 gms.
(3) Caustic Soda—250 gms
(4) Copper sulphate—100 gms
(5) Glycerine—1-2 gms
(6) Iodine—2 gms
(7) Common Salt—100 gms
(8) Methylated spirit—50 gms
(9) Potassium permanganate—50 ml
(10) Sugar—250 gms.
(11) Vaseline/petroleum jelly—50 gms
(12) Washing Soda—100 gms.

V A SET OF CHARTS

It is proposed that a set of charts will also be supplied.

Examples of Improvisations

1. Scale Half Metre with Five Holes
(*Item No.* 32.)



Requirements

(i) Mainly for demonstration purpose.
(ii) Should be able to impart the idea about submultiples of metre to children.
(iii) Visible from a distance of six metres.
(iv) Sturdy enough to work as a lever.
(v) Light enough to be handled by children
(vi) Should not be costly.

Uses

(i) For measuring distance.
(ii) To draw lines on blackboard.
(iii) To act as a lever.

Concepts

(1) Measurement of lengths
(ii) Principle of lever.

The Prototype

The prototype satisfies all requirements. It is made of soft wood with black base Each graduation in white as well as black corresponds to one centimetre which is clearly visible from a distance of six metres. Loads could be suspended to enable it function like a lever. It is quite inexpensive.

2. LAMP (KEROSENE) (*S No. 34*)

Requirements

(i) To be a source of heat for experiments.

(ii) Parts to be replaceable.

(iii) Fuel should be available in small villages.

(iv) Simple in operation and handling.

(v) Should give smokeless flame.

(vi) Should be inexpensive.

Uses

(i) As a source of heat.

Concepts

(i) Heat energy.

Availability

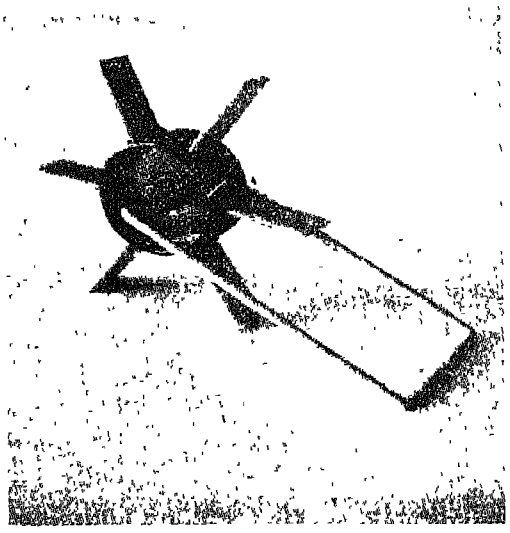
Available as a spirit lamp but the fuel spirit is not easily available.

In fact the requirements were to improvise a substitute for a spirit lamp, since spirit is not available in villages The task was to design a smokeless kerosene lamp from ordinary material.

The Prototype

The prototype fulfils all the needs and offers a great flexibility in using different size of ink bottles. Stopper is made of hard rubber (ebonite) having three steps for normal sizes of ink bottles available in the country. The wick is made of unspun cotton which is available everywhere.

3. WATER WHEEL (*S. No* 41)



Requirements

(i) A device to indicate conversion of energy of the falling water stream into mechanical motion.
(ii) Should be light and portable.
(iii) Should be small and simple in construction.
(iv) Should be inexpensive

Uses

(i) As a small water wheel.

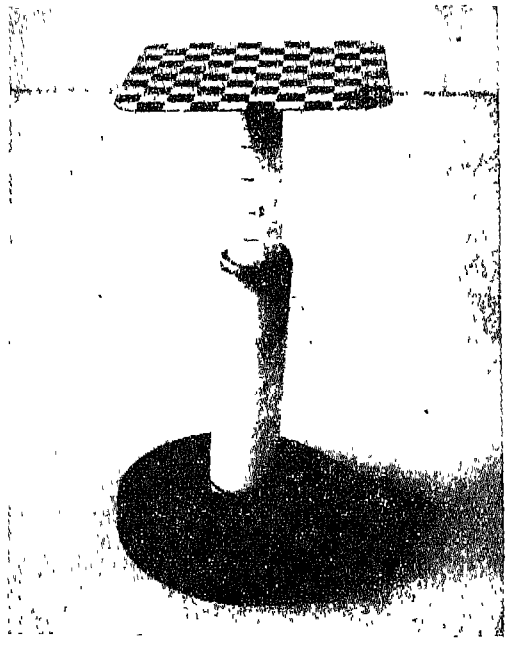
Concepts

(i) Conversion of energy

The Prototype

The prototype satisfies all the requirements. It is small and light so that children can easily handle it. The experiment can be performed either by using a water tap or by providing a small hole at the bottom of a water container. It is frictionless and works even on blowing air from mouth.

4. TOP PAN SPRING BALANCE—2 Kg (*S. No.* 47)



Requirements

(i) A simple device for measuring weight.
(ii) Both for demonstration and pupil's use
(iii) Convenient to handle.
(iv) Easy to illustrate its working.
(v) No precision weighing required.
(vi) Inexpensive.

Uses

(i) For weighing.

Concept

(i) Measurement of weight.

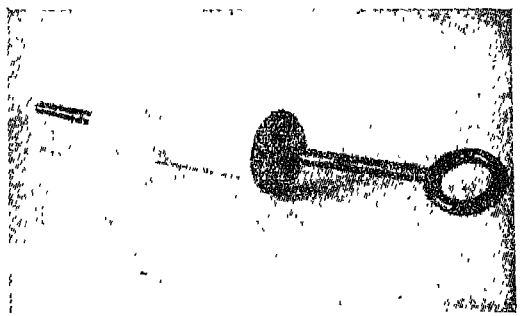
Availability in the market

Either hanging type spring balances or

The Prototype

The prototype meets all requirements. It carries four graduations of ½kg. each which are visible from a distance The top provides an easy handling The result of weighing can be known immediately without any other efforts. Hanging by means of hooks and strings is altogether eliminated Various parts can be dismantled for showing to children.

5. MODEL OF A LIFE PUMP (*S No* 48)



Requirements

(i) Device to illustrate the working of a lift pump.
(ii) A small and simple model which can be handled by children
(iii) To allow visibility it should be made of transparent material.
(iv) Should be inexpensive.

Uses

(i) To illustrate the working of a lift pump.

Concept

Principle of lifting water through the use of air pressure.

The Prototype

The prototype is a very simple and cheap device to meet the requirements. Body made of transparent polystyrene allows vision of the functioning of seat valve so that the teacher can guide the students as to what is happening inside. It could be handled by the students as well.

LIST OF ACTIVITIES

Class 3

S. No.	*Name of the Activities*	*Equipment and Materials*
CHAPTER 1	OUR UNIVERSE	
1	Why does the earth appear to be flat?	Large ball, water pot or a globe, small ball and a round small-coin
2	How is it possible to travel around the earth ?	A large ball, globe or water pot, a small stick, a piece of chalk
3	What causes night and day?	Large ball, water pot or globe, Petromax, torch or candle, chalk
CHAPTER 2	AIR, WATER AND WEATHER	
4	What happens to ice when it melts?	Ice, metal tumbler or tin can
5	What happens when you wet your hands and blow on them?	Hand fan or cardboard, water
6	Does the air temperature vary during the day?	0°-110° Celsius (or Centigrade) thermometer
7	Is the temperature higher in the sun or in the shade?	A 0°-110° C thermometer
8.	Why is the sun warmest when directly overhead?	Cardboard or heavy paper, 30 cm square, scissors or blade

9	How can we make and use a wind vane?	A bamboo or stick 50 cm long, a piece of wood, 20-30 cm. long and 3 cm square
CHAPTER 3 · ROCKS, SOILS AND MINERALS		
10	Do soil particles differ in size?	Sand, clay, hand lens, soil samples
11	What materials do you find in soil?	Glass tumbler containing soil sample
12	Which soil holds most water clay, sand or loam?	3 flower pots, 6 bricks, 3 tumblers, samples of clay, sand and loam
13.	What is formed when two rocks are rubbed together?	Hand lens, 2 rock pieces
14	In what other ways are rocks weathered?	Hand fan, piece of newspaper, sand
CHAPTER 4 . FORCES AND WORK		
15.	What is force?	—
16.	How do we use forces when we play?	None needed
17.	What happens when you kick a ball with two different forces?	Ball, large field
18	What is the force that comes from gravity	Ball, brick or stone
19	Does the weight of an object exert force on the surface on which it rests?	Top pan balance, 2 bricks
20	Does any force come from a magnet?	Magnets, nails, other small objects
21	Is there any force in electricity?	Comb or pen, soft nylon cloth or terylene cloth or cotton cloth, small pieces of paper
22	How do our muscles exert force to do our work?	Brick, table or desk
23	Why do carts have wheels?	Brick, smooth and rough surfaces, rollers such as round pencils
24	What do we mean by friction?	—
25.	How can we measure area?	Sheets of paper, metre scale or other suitable scale
26.	What do we mean by temperature?	Glass jar or tumblers, thermometer, hot and cold water, ice
CHAPTER 5 · MATTER AND MATERIALS		
27.	What is the difference between a solid, a liquid and a gas?	Water, stone
28.	How can matter in one state be changed into matter in another stage?	Ice, tin can
29	Can water-vapour be changed back into water or ice?	Metal plate, pot
30	What are the shapes of solids, liquids and gases?	Stone, tumbler, ink, water
31	How do we know that air occupies space?	Small glass jar, piece of paper, bowl of water
32.	What is air pressure?	Sheet of newspaper, 20 cm. scale
33	Can salt be dissolved in water?	Glass jar, salt
34.	Will hot water dissolve more salt than cold water?	Metal pot, water, salt
CHAPTER 6 HOUSING AND CLOTHING		
35	How does a house provide shelter and comfort?	Discussion based on observations
36	How does one make a sump in the garden?	Discussion based on observations
CHAPTER 7 LIVING THINGS		
37.	Do plants grow?	Flower pots, soil, bean or other seeds
38	Do snails and earthworms react to their surroundings?	Burner, glass or metal rod, snails and earthworms, sheet of paper

39	Do plants react to light?	2 cardboard boxes, 2 flower pots, 2 similar plants
40	Do plants reproduce?	Flower pots, seedlings, soil

CHAPTER 8 PLANT LIFE

41	What are the parts of a plant?	A plant, water, sheets of paper
42.	Are roots essential for plant growth?	Flower pots, plants, soil
43.	Why are roots essential for plant growth?	2 glass jars, 2 garden plants, red ink
44	How do water and salts from the roots rise up to the leaves?	Beaker or glass jar, red ink, hand lens, razor blade
45.	What is the work of a flower	Flower garden
46	What is a plant life cycle?	Flower pots, seeds or seedlings of a plant with a short life cycle—such as pea, bean or mustard
47.	Does soil contain salts?	Metal bowl or pot, burner, stand for pot, soil, and water
48	How do these salts help the plant grow?	2 flower pots, crushed brick dust, garden soil bean seeds
49	What things make up the humus of the soil?	Garden soil, glass jar, water, hand lens

CHAPTER 9 ANIMAL LIFE

50.	How do birds eat?	Discussion based on observations
51	What special features are found in the teeth of meat-eating animals?	Discussion based on observations
52.	How do we know that even meat-eaters depend ultimately on green plants for their food?	Discussion based on observations

CHAPTER 10 . BIRDS

53.	What is it in their wings that help birds to fly?	Discussion based on observations
54.	How do the wings and tails of birds help them to fly?	Pieces of paper, model glider
55	How do ducks, geese and other water birds keep themselves dry?	Freshly plucked feathers from a duck and a hen, basin of water
56.	How do the feet of ducks help them to live on water?	Pieces of cardboard, rubber bands of strings, pail of water
57	How can we use a bird table?	Pole or post 1-½ metres in length and 10 cms. in diametre
58	Do different birds build different kinds of nests?	As many different nests as the children may gather

CHAPTER 11 : YOUR BODY AND HEALTH

59	How does chewing help in digestion?	Pieces of *chapati* or bread
60	What pumps the blood throughout your body?	Chart
61	Does the heart always beat at the same rate?	A clock or watch with a seconds' hand would be useful.
62	What happens to your chest when you breathe in and out	A piece of string about a metre long
63.	What waste is removed from our lungs when we breathe out?	A small mirror

Class 4

CHAPTER 1 . OUR UNIVERSE

1	What is a planet?	A rope or piece of string
2.	How do these planets orbit around the sun?	Rope, two sharp sticks

3	Why do the other stars not give us heat and light?	Candle
4	Why are the stars not visible during the day?	A piece of black or brown paper, at least 50 cm square
5	What does a constellation look like?	do
6.	How are volcanoes formed?	Plastic bag, mud, pin
7	How do positions of the earth change as it orbits the sun?	A globe or a ball and a pump

CHAPTER 2 · AIR, WATER AND WEATHER

8	How does the sun affect land and water?	Two wide mouthed basins, measuring cylinder, spring balance, thermometric
9.	What happens to water when it is left in a vessel for some time?	A glass jar, strip of paper, glue
10.	Does water evaporate more rapidly in the sun or in shade?	Two bowls, water
11.	Does water evaporate faster on a windy day?	Two pieces of cloth of the same material and of equal size, hand fan or electric fan
12.	Does the extent of surface area affect evaporation?	Two pieces of cloth, water
13.	What happens when water vapour is cooled?	A kettle or pot of water, a metal plate, a burner
14	What is safe water?	Bucket to collect rain water
15	How do we make water safe for drinking?	Two glass jars, rubber tube, flower pot, sand piece of cloth
16.	How is water stored underground?	Tin can and sand

CHAPTER 3 : ROCKS, SOILS AND MINERALS

17.	What do soil layers look like?	Spade
18.	How does water wash away the top soil?	Spade or shovel, sand or light soil
19	How does wind blow away the top soil?	Sand, piece of paper, book or hand fan
20	How do we protect the top soil?	Two empty boxes, sand, turf, water, watering can
21.	How is soil protected by terraces?	Two boxes, supply of stones, sand or soil

CHAPTER 4 : WORK, ENERGY AND MACHINES

22.	How is the energy of falling water used to do work?	Empty cotton reel, metal sheet, metal rod or nail, bucket, water
23.	How is the energy of steam used to do work?	Water wheel, kettle of boiling water
24.	How is the energy of electricity used to do work?	Electric motor copper wire, battery, switch
25.	How is electricity used to make a magnet?	Copper wire, battery, large nail, small nails, circuit board
26.	Do we produce heat when we do some work?	Two pieces of stone
27.	How does a simple machine help us to do work?	Wooden plank
28	How do pliers help us to do work?	Hammer, pliers, nails, wooden board, pliers, scissors and nutcrackers, if available
29	What is lever?	Short plank, two or three bricks, a small stone
30	What is volume?	Empty bottle, measuring cylinder
31	How much is a litre?	A hollow cube of one litre capacity, measuring cylinder, scale
32.	Do solids of equal volume have equal weight?	Top pan balance or spring balance, 3 or 4 blocks of different materials, e g , iron, wood, lead and aluminium

CHAPTER 5 . MATTER AND MATERIALS		
33	Do all things change when they are heated?	Wax, teaspoon, sugar, burner
34	What happens to potassium permanganate crystals when they dissolve in water?	Beaker or glass jar, potassium permanganate crystals
35	When solids dissolve in water, does the water level change?	Jar or tumbler, piece of sticky paper, salt, teaspoon
36.	What happens to the salt when it dissolves in water?	Empty jam jar 50 marble pieces, 200 gms of green gram
37	How do we know that water dissolves gases?	Bottle of any aerated water
38	Are there gases dissolved in pond, stream, and river water?	Beaker, burner
CHAPTER 6 HOUSING AND CLOTHING		
39	Why do you feel hot and uncomfortable in a hot, stuffy room?	Beaker, burner
40.	Where does the hot air go?	Incense stick, matches
41.	What kind of materials are house roofs made of?	Pictures of different kinds of roofs
42	How are clothes made from thread?	Samples of cloth pieces
CHAPTER 7 LIVING THINGS		
43.	What kind of animals and plants live in a pond?	Hand net, empty jam jar for collecting, hand lens
44	What kind of plants and animals live in dry waste land?	Hand lens, collecting jar
45	In what sort of places do animals live?	Pictures of animals and their habitats
CHAPTER 8 PLANT LIFE		
46.	Is sunlight needed for plant growth?	Two potted plants, a dark cupboard
47.	Is water necessary for plant growth?	Two healthy potted plants
48	Do all plants make their own food?	Toadstools and mushrooms, two pots with soil, some bean seedlings
49.	How do toadstools and other non-green plants get their food?	Mouldy bread, decaying fruit
50	Which plants form the main food of man?	Seeds of rice, wheat, millet
51.	Do animals also use grass plants as their main source of food?	
CHAPTER 9 . ANIMAL LIFE		
52.	Which animals give birth to living young?	Discussion based on observations
53.	Do all animals give birth to their young?	do
54	Do other animals lay eggs also?	do
CHAPTER 10 HUMAN BODY, HEALTH AND HYGIENE		
55	Why do we eat cooked food?	Some raw rice, potato or any other food which is normally eated cooked, burner, a container suitable for cooking
56	Why should we use the water used for cooking vegetables and not throw it away?	Beans
57.	How does food spoil?	Boiled potatoes
58.	How can we make a food cooler?	A plastic dish, garden pot, bricks, large piece of cloth, thermometer
59.	Why is it necessary to have strong healthy teeth?	Raw carrot washed in safe water

60.	Do your teeth help you in any other ways?	Discussion based on observations
61.	How many different types of teeth do we have?	do
62.	How do we care for our teeth?	Neem twigs, tooth brush and tooth paste or dental powder

Class 5

CHEPTER 1 : OUR UNIVERSE

1.	How are the tides caused?	
2.	How do shadows occur?	A ball, a wooden block, torch
3	How does an eclipse of the moon occur?	Two balls, torch
4.	How does an eclipse of the sun occur?	Two balls, torch

CHEPTER 2 : AIR, WATER AND WEATHER

5.	How does water rise, when people drink through a straw?	A jar or drinking glass, drinking straw
6.	How does a syringe or a fountain-pen-filler work?	Syringe or fountain-pen-filler
7	How does a lift pump work?	Model of a lift pump
8	How can a liquid from one jar be transferred to another without tipping the contents of one into the other?	Plastic tubing, two jars, bricks or blocks to provide an elevated surface
9.	Does burning require something from the air?	Candle, two glass jars of different size, match box
10.	How is exhaled air different from that which we inhale?	Two test tubes, lime water, drinking straw
11	What happens when a fresh water plant, such as *Hydrilla*, is kept in a jar of water in sunlight?	*Hydrilla* plant, jar, filter funnel, test tube
12.	How can we obtain dissolved substances from a solution?	Test tube or a metal spoon, common salt, lamp for heating
13.	How do we remove insoluble substances from water?	Two tumblers or any other glass containers, muddy water
14	How can water be freed from all insoluble particles?	Funnel, tumbler, filter paper, beakers, glass rod

CHAPTER 3 : ROCKS, SOILS AND MINERALS

15.	What causes the layers to be formed in the sedimentary rocks?	Glass jar, sand, gravel and soil
16.	What does an igneous rock look like?	Granite pieces, pestle and mortar, magnifying glass
17.	What are the shapes of crystals of common salt, sugar, copper sulphate, alum and marble?	Crystals of common salt, sugar, copper sulphate, alum and marble, hammer, magnifying glass
18.	In what different ways are rocks used?	Discussion based on observations
19.	What minerals are used as fertilisers?	A chart like that given in the book
20.	How are metals like aluminium, copper, silver, and gold used in our modern way of life?	Pictures, articles made of aluminium and copper
21	How is petroleum obtained from the earth?	Some suitable pictures and charts

CHAPTER 4 . FORCE, WORK AND ENERGY

22.	What do we understand by the density of a substance ?	Aluminium, iron and wood blocks, spring balance
23	How many times is milk heavier than water?	Three similar test tubes, water, kerosene, and milk
24	How do liquids exert pressure?	Any cylindrical vessel with holes

25	Does water exert pressure in a downward direction?	Water, tin, wax
26.	Are equal pressures exerted in different directions at the same depth?	Empty tin, bucket of water
27	What is the role of liquid pressure in the floatation of an object?	Dry wood block, spring balance and thread, water
28	Do objects that sink weigh less in water?	Block of iron, water, spring balance, thread
29.	How does a wedge work?	Knife, wood wedge, metal wedge, razor, chisel, log of wood, and hammer

CHAPTER 5 . MATTER AND MATERIALS

30	How far can we go on breaking a chalk stick into pieces?	Chalk stick, a stone to grind the chalk
31	How far can one go on reducing the size of the particles of any substance?	Test tube, potassium permanganate crystals, hand lens
32	Does sugar also break into tiny particles when dissolved in water?	Beaker, sugar crystals, spoon, hand lens
33	Are there spaces between the molecules?	Glass jar, paper strip, gum arabic, teaspoon, salt. other soluble solids such as sugar, alum and copper sulphate
34.	Are the molecules fixed or are they in motion?	Test tube, potassium permanganate crystals
35	Are the molecules in air in motion?	Discussion based on observations
36	How can a dissolved salt be recovered from its solution?	Common salt, teaspoon, water
37.	What is the effect of supplying ammonium sulphate to a plant?	Two similar potted plants, ammonium sulphate
38	What is the effect of a phosphate fertiliser on the growth of the plant?	Phosphatic fertilisers, two potted plants

CHAPTER 6 . HOUSING

	No activities	NIL

CHAPTER 7 : PLANT LIFE

39.	How many seeds does a single paddy or wheat plant produce?	Ten heads of wheat or paddy
40.	Is water necessary for the germination of seeds?	Seeds of mustard, two pieces of cloth, two pans
41	Is air necessary for the germination of seeds?	Ten bean seeds, wide mouthed jars (2), a litre of boiled and cooled water.
42	How are seeds dispersed from the parent plant?	
43.	What kind of a climate is needed for our most important crops?	Discussion based on observations
44.	What are the natural enemies of a crop?	do.

CHAPTER 8 : ANIMAL LIFE

45	How do fish swim in water?	A jar containing water and a local fish along with some wood or scum from a pond.
46.	How do fish breathe in water?	do.
47.	How do fish feed in water?	A fish in a jar of water, some worms or grubs or some dough
48.	How are water insects adapted to live in water?	A jar containing pond water with common water insects such as backswimmer and other species
49.	How are monkeys adapted to live in trees?	Discussion based on observations

50	How are the feet of fast running animals suited to their way of life?	Pictures of deer, cattle, horses
51	Do all land mammals have hard roofs?	Pictures of legs and feet of a wide range of mammals
52	How are animals that live underground adapted to their way of life?	Some earthworms, burrowing insects or creatures
53	How do butterflies obtain nectar from flowers?	Discussion based on observations
54.	In what different ways do insects feed?	Collection of beetles, water bugs
55	How do insects breathe?	The large flying grasshopper or locust
56.	Are the wings of birds like the limbs of other animals?	Wing of bird

CHAPTER 9 . MAN AND HIS WORLD

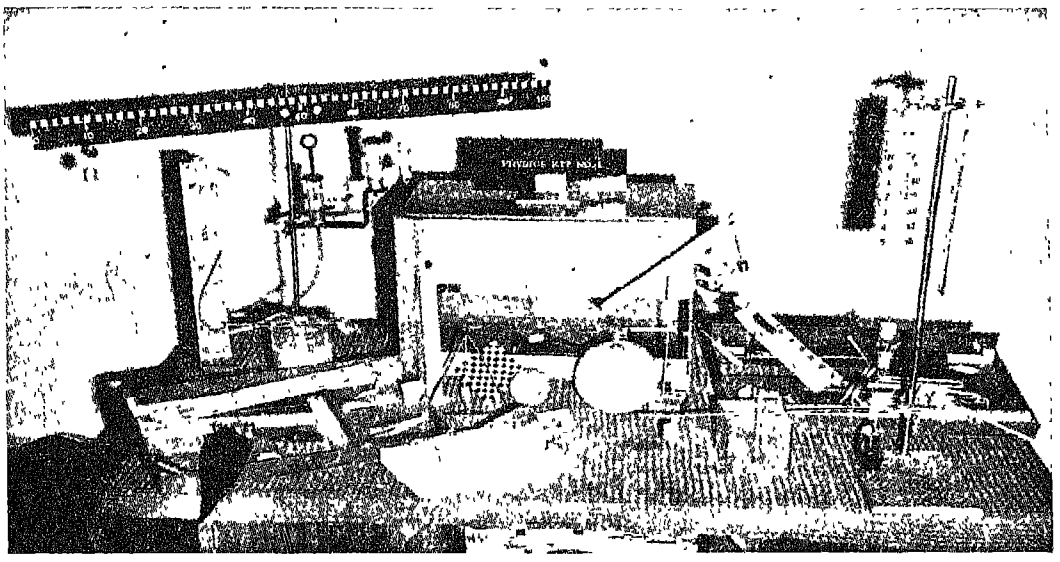
	No activities	NIL

CHAPTER 10 : HUMAN BODY, HEALTH AND HYGIENE

57.	What makes your skin sensitive to heat, cold and touch?	Discussion based on observations
58.	How do different organs of the body work together?	A chart showing the brain and spinal cord in man
59.	How do sensory nerves function?	A piece of cloth for blind-folding and a corn
60.	How do sensory nerves in your tongue function?	Piece of cloth for blind-folding, some crystals of sugar
61.	How do you hear?	A chart showing the parts of human ear
62.	How do sensory nerves and motor nerves work together?	A jig-saw puzzle
63.	How do we take care of our eyes?	A torch
64.	How do we protect the eyes from disease and injury?	Charts or pictures showing people suffering from eye diseases and injuries
65.	What protects the brain, eyes, ears and nose from injury?	The skull of a dog, cat or other mammal
66.	How is the spinal cord protected from injury?	A chart showing the structure of the spinal cord and backbone
67.	How do we move our limbs and joints?	Discussion based on observations
68.	How do the muscles help your arms and legs to move?	do

PHYSICS DEMONSTRATION KIT NO. I

D.S.E. (C S W) II



The new 3-year middle school science course has been designed as separate disciplines of physics, chemistry and biology. Physics is introduced in the first year of the middle school along with biology. Chemistry is to be taken up from the second year. Physics being a major subject, a kit for each of the three classes of middle school has been developed. Beside these, there is pupil's kit for each class.

Physics Demonstration Kit No. I has been developed for the first year of the middle school. This is a complete laboratory in a wooden box measuring 530×290×365 mm. consisting of several trays. In general, each tray contains improvised apparatus on a particular topic, yet it is not strictly possible, due to the limited number of trays and multipurpose use of a particular item. The kit also contains consumable material which will suffice for at least one year and after that it can be replenished for a small amount of money.

The kit comprises 86 different items including the kit box. Most of the items have been improvised, although a few consist of direct purchased material. Attempts have been made to utilize the same item in different situations, instead of duplicating it. Similarly, it is taken for granted that the schools will also have a primary science kit which contains hand tools. So, no hand tools have been included.

Although the kit is meant for demonstration purpose by teachers, the pupils can also perform experiments by supplementing with a few items Under ideal conditions, however, this kit should always be supplemented with the Physics Pupils's kit No I to form a comprehensive physics laboratory for the first year of the middle school. The kits do not create any storage problem.

The kit guide for this kit is more detailed. It contains the list of items of kit and a list of suggested demonstrations/pupil experiment topic-wise, indicating use of particular items. It also contains sketches, lists of parts and use of the particular items for explaining different concepts.

Reference books published (NCERT)

(*a*) *Textbook*

Physics, Part I, Science for Middle Schools (Revised ed. 1970)

(*b*) Teacher's Guide for the above textbook

(*c*) Kit Guide

Scientific Topics covered under the New Curriculum

(*i*) Introduction to Physics
(*ii*) Measurement.
(iii) Force, weight and Pressure.
(*iv*) Structure of substances.
(*v*) Some properties of solids, liquids and gases
(*vi*) Pressure in fluids.

List of items

P-1. Metre scale-*cum*-lever (bevelled), scale division 1 cm.
P-2 30 cm. ruler-*cum*-lever, scale division 1 mm
P-3. Tailor's measuring tape, scale division 1 mm.
P-4. (*i*) Rubber balls, dia, 80 mm. (pair)
(*ii*) Rubber balls, dia 50 mm (pair)
P-5. 30 cm Plastic scale (bevelled)
P-6. Right-angled triangular sheet
P-7. Hollow sphere
P-9. Graph paper (metric), 100 cms ×70 cms.
P-10. Regular figure (circle)
P-11. Irregular figure (human foot impression)
P-12. Support
P-13. Unit cu. cm. block (25 Pcs)
P-14. Hollow unit cu. dm. vessel (transparent
P-15 Unit cu. cm. spoon
P-16. Measuring cylinder, 500 ml.
P-17. Measuring cylinder, 100 ml
P-18. Wooden block *cum* test tube stand
P-19. Dropper
P-20. Foot ball bladder (No 2 size)
P-21 Rubber strip, 100×50×10 mm.
P-22. Rubber strip, 100×20×1 mm
P-23. Rubber bands (25 Pcs.)
P-24. Compression-*cum*-extension spring having a free length of 100 mm. coil dia 30 mm, material spring wire of 1 mm. dia
P-25 Extension spring having a free length of 100 mm., coil diameter 15 mm, material-spring steel wire of 1 mm. dia.
P-26. Spring balance (open type), range 0-500 g. wt. (pair)
P-27 Spring balance (pupil's) range 0-100 g wt. (pair)
P-28 Set of five weights, each of 100 g.
P-29. Simple level
P-30 Device to show dependence of pressure on area
P-31 Steel strip, 300×20×1 mm
P-32 Aluminium strip, 300×20×1 mm.
P-33. Coil having a free length of 100 mm., coil dia 30 mm, material-Aluminium wire of 1 mm dia
P-34. Magnets (pair)
P-35 Set of 15 discs, dia of each-40 mm (for explaning the elastic and plastic deformations)
P-36. Set of 25 marbles
P-37 Frame for marbles of P-36
P-38 Lead cylinders (pair)
P-39 Device for cleaning face of lead cylinders
P-40. Mercury drop in sealed transport tube
P-41 Drawing pins (10 Pcs.)
P-42 Cylinder with holes
P-43 Rod for expansion of solids
P-45 Pointer for expansion of solids
P-46. Bimetallic strip
P-47 Rubber stopper with narrow bore tube (to be fitted to test tube)
P-48 Pinch Cock (2 Pcs)
P-49. Thermometer, laboratory type
P-50 Football pump
P-51. Rubber stopper with tubes for demonstration of Pascal's law
P-52. Pascal's ball
P-53. Pair of interconnected tubes
P-54 Model of spirit level
P-55. U-Tube for manometer
P-56. Manometer stand
P-57. Scale for manometer and model of thermometer
P-58. Strip for model of Celsius scale
P-59. Model showing deflection under internal pressure
P-60. Inter connected vessels of different shapes
P-61 Wide transparent tube (internal dia. 36 mm × 250 mm long) with piston
P-62. Device for pressure in liquids
P-63. Rubber suckers
(*a*) Large with handle (pair)
(*b*) Small with handle (pair)

P-65. (*i*) Plastic bag 500 ml. capacity
(*ii*) Plastic bag 150 ml. capacity
P-66. Metal sheet unit sq dm. graduated into sq cm.
P-67. Metal sheet box with small hole made from unit sq dm sheet
P-68. Cork for floatation
P-69 Set of similar cylinders, made of different substances viz M S aluminium, brass and lead
P-70. Set of cylindes, each having the same mass and diameter, made of differnt substances viz M S aluminium, brass and lead
P-71. Magnifying glass (5×)
P-72 Test tube (pair)
P-73. Beaker-*cum*-overflow can
P-74. Conical flask, 500 ml
P-75 Wooden Wedge (3 Pcs.)
P-76. Small bottle
P-77 Laboratory lamp
P-78 Paper clips (20 Pcs)
P-79. Laboratory stand
P-80. Laboratory stand clamps (2 Pcs)
P-81 Plasticine, 50 gms
P-82, Match box (1 Pc)
P-83 Rubber balloons, large and medium size (6 Pcs)
P-84. Large candles (2 Pcs)
P-85 Cello tape (2 roll)
P-86 Standard box
N B P-8, P-44 and P-64 have since been omitted

Examples of Improvisation

6 Hollow Decimetre Cube (*P-14*)

Requirements

(i) To serve as an educational one-litre measure for liquid capacity and unit decimetre cube for volume measurements.

(ii) To have 10 equal graduations marked on one of its faces.

(iii) To serve as a transparent vessel.

(iv) To be durable and sturdy enough to stand rough handling.

(v) Should not be costly

Uses

(i) To impart ideas of unit decimetre cube volume and one litre capacity to the class.

(ii) To obtain 1 kg. weight of water.

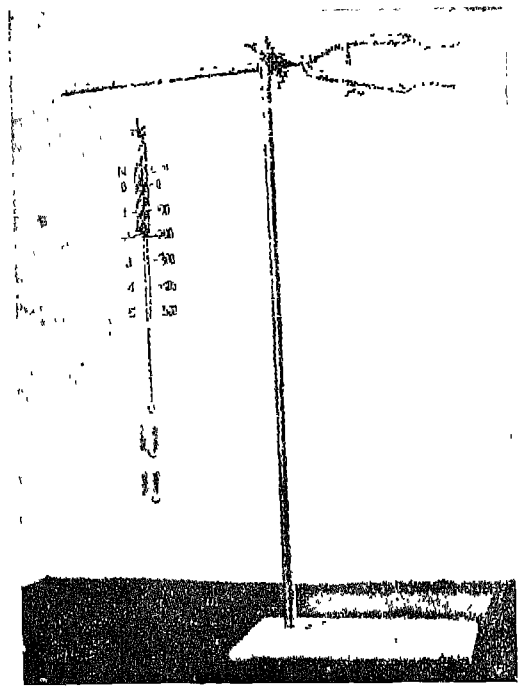
(iii) As a transparent vessel for use in various teacher demonstration experiments on floatation and pressure in liquids.

(iv) As a block for support for various experiments, especially, in the case of demonstration of a thermal expansion of solids.

The Prototype

The prototype satisfies all the requirements. Made of polysterene, it is transparent and sturdy. There are ten equal graduations marked on one of its faces. It can contain one litre of water. It can be put to multipurpose use and is quite inexpensive.

7. Spring Balance (Open type) (*P-26*)



Requirements

(i) Suitable for use in teacher demonstration experiments.
(ii) Designed to expose its construction.
(iii) To be durable and sturdy.
(iv) With scale having graduations in Newton and gramweight units.
(v) With accuracy of 5 per cent to measure forces in the range 0 to 500 g. wt. with least count of 10 gms.
(vi) Pair of identical spring balances.
(vii) Should not be costly.

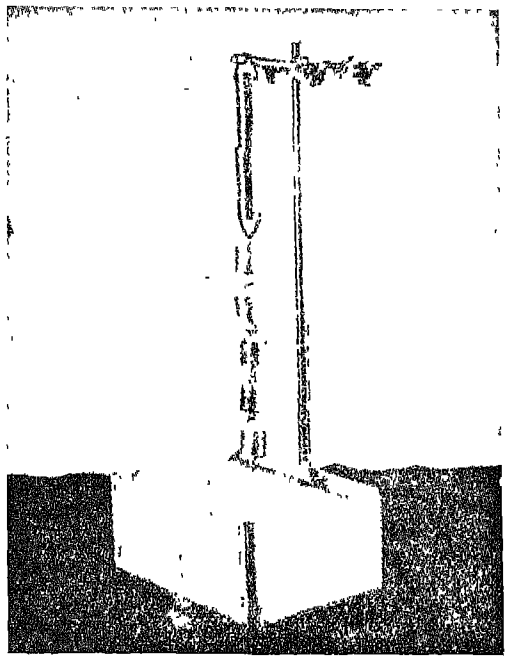
Uses

(i) For explaining construction and principle of working of a spring balance.
(ii) For measuring forces involved in various teacher demonstration experiments such as pulling.
(iii) For demonstrating law of composition of forces (using a pair).
(iv) For studying Archimedes Principle (using a pair)

The Prototype

The prototype is simple, sturdy and open model of a spring balance to measure 0—500 gm. wt. There are ten graduations which are easily visible from a distance of six metres. These graduations are both in Newton and gm. wt. The frame is made of polythylene which is durable. It does not have any complicated component.

8. Lead Cylinders (*P-38*)



Requirements

(i) To enable the demonstration of molecular forces of attraction (cohesion).

(ii) Size, shape, and design of two pieces of pure lead and a cutter to facilitate teacher demonstration.

(iii) The cutter to be efficient, durable and sturdy.

(iv) The pair should be made of similar pieces of lead provided with suitable hooks.

(v) Should not be costly.

Uses

(i) For showing the effect of molecular forces of attraction in a solid substance (lead).

(ii) For use as a pair of spare loads.

The Prototype

The prototype consists of a pair of cylinders which are made of mild steel and lead. The lead portion is towards the tip and the mild steel portion is towards the hooks for hanging the cylinders. These cylinders are cadmium plated so that each one looks as if made of one metal only. This is very effective in use.

Caution : Tip of each cylinder should be cleaned by the special device provided in the kit box separately, before these are pressed together and hung.

9. Pascal's Ball (*P-52*)

Requirements

(i) A device to show Pascal's law that the liquids exert pressure equally in all directions.

(ii) Easy to handle and eliminate the use of force pump.

(iii) To be inexpensive and durable.

Availability

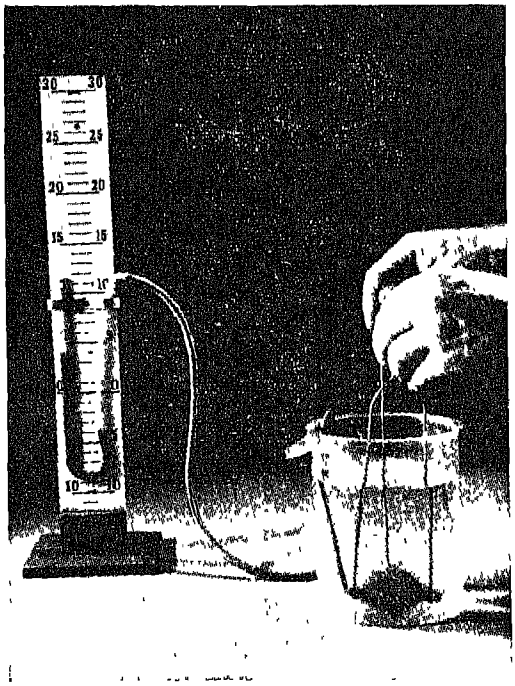
Conventional apparatus available but expensive.

The Prototype

A rubber ball of 80 mm. dia. has been provided with four small side holes and one big hole at the top. The ball is held by hand and water is filled through the big hole at the top. After that the big hole is closed by the thumb and the ball is squeezed. It will be observed that water sprays out in all directions with the same pressure.

The cost is almost negligible. The device is easy to handle and durable.

10. Device for Pressure in Liquids (*P-62*)



Requirements

(i) A device to indicate that the pressure in liquids from all directions at the same depth remains constant.

(ii) Suitable to be fixed on the laboratory stand for demonstration.

(iii) To be easy to handle, inexpensive and durable.

Availability

No such apparatus available

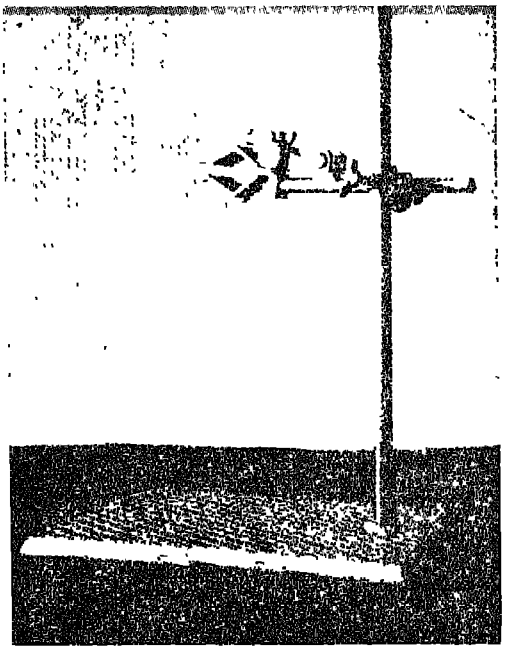
The Prototype

A small cup-shaped plastic vessel is provided with a fine rubber diaphragm on the top. This vessel can rotate around a horizontal axis at the level of the rubber diaphragm with the help of a lever. The vessel is mounted on a frame which can be fixed to the laboratory stand. The vessel has a hole which is connected to a manometer by means of a rubber tube.

The vessel is placed inside a plastic beaker. The level of water in the manometer is noted. The vessel is then put in three different positions firstly, diaphragm on top, secondly, diaphragm vertical and then the diaphragm at the bottom. The water level in the manometer will remain constant.

The device is simple, inexpensive and durable.

11. Laboratory Stand (*P-79 & 80*)



Requirements

(i) To serve as a raised support and also as a stand for various teacher-demonstration experiments

(ii) Its clamp to have a long rod so that when needed the other side could be used as a support.

(iii) Its rod to be made up of two pieces to suit its packing in the kit; the two pieces could be screwed up or unscrewed easily.

(iv) Should have a heavy detachable base.

(v) Should be durable and sturdy enough to stand rough handing.

(vi) Should not be costly.

Uses

(i) As a stand and a support in various teacher demonstration experiments.

(ii) As a special body for demonstrating some characteristics of force.

(iii) Its rod to have threading in common with that of the piston of the hollow plastic tube, when used as a handle of this piston.

(iv) Piece of the handle to be used as spare cylindrical metallic-bodies

The Prototype

The Prototype was designed keeping in mind its universal use and limitation in despatch. As it forms one of the items of several kits, it was to be placed inside the kit box A heavy cast iron base is provided containing screwed hole where rod of the stand can be fixed up. This rod has been made in two parts—one can be screwed on to the other while using The two parts can be easily accommodated inside any of the kit boxes.

LIST OF SUGGESTED DEMONSTRATIONS—EXPERIMENT WITH THE ITEMS OF EQUIPMENT FROM THE PHYSICS KIT INDICATED AGAINST EACH

Description of Experiment	*Items to be used from the Kit*
1 INTRODUCTION TO PHYSICS	
I-1. Solid, liquid and gaseous substances commonly available	p-1, p-20, p-21, p-70, p-73, p-83
I-2. Simple physical properties of some bodies. (elastic/plastic, transparent/opaque, light/heavy)	p-14, p-18, p-22, p-24, p-32, p-69, p-81
I-3. Some physical phenomena (falling of bodies floatation of bodies and formation of shadows)	p-13, p-18, p-66, p-67, p-70, p-73
I-4 Some common appliances based on principles of physics (spirit level, magnifying glass, hand torch and some working models)	p-46, p-49, p-54, p-71
II MEASUREMENT OF LENGTH, AREA AND VOLUME	
II-1 Model of metre scale with dm., cm , and mm markings	p-1, p-43, p-79, p-80
II-2 Correct measurement of length and the errors due to incorrect placement of scale	p-1, p-2, p-3, p-5, p-86
II-3 Errors in measurement due to parallax and the method to avoid them	p-1, p-31, p-32, p-56, p-79, p-80, p-81
II-4. Use of bevel scale	p-1, p-2, p-5, p-14, p-18
II-5 Use of blocks and scale for measuring diameter of round bodies etc	p-2, p-4, p-5, p-7, p-14, p-18, p-61
II-6 Use of measuring tape	p-3, p-73
II-7 Use of thread for measuring curved lenghts	p-2, p-41 and inelastic thread
II-8. Models of unit sq m , sq dm., sq cm , and sq. mm surface areas	p-9, p-13, p-66
II-9 Measuring rectangular surface area by using graph papers and comparing it with its area calculated by measuring the linear dimensions	p-2, p-9, p-18
II-10. Use of graph paper for measuring surface area	p-9, p-10, p-11
II-11. Model of unit cu cm, cu dm, volumes	p-13, p-14, p-15
II-12. (a) Model of unit litre and millilitre in the form of a cu dm, and cu. cm	p-14, p-15, p-73
(b) Some measuring cans and measuring vessels	p-14, p-16, p-17, p-73
II-13. Graduating measuring vessels	p-15, p-16, p-17, p-19, p-72, p-73, p-85
II-14. Use of measuring vessel for determining the capacity of a bottle	p-16, p-17, p-73, p-76
II-15. Use of a measuring vessel for determining the volume of a solid body	p-16, p-17, p-28, p-73
II-16. Use of an overflow can for determining the volume of a large solid body	p-4, p-16, p-73

III. FORCE, THRUST AND PRESSURE

III-1.	(a) Effects produced by muscular force on bodies (change of state of motion of a body and its direction, and deformation of a body,	p-4, p-21, p-22, p-24, p-81
	(b) Interaction between two bodies as the action of force	p-4, p-14, p-24, p-28, p-79
III-2	Effects produced by other forces (i) Mechanical, (ii) Gravitational, (iii) Electrical and (iv) Magnetic	p-4, p-14, p-18, p-34, p-61, p-68, p-79, p-80, p-86 (only one shelf)
III-3.	Extensions produced in a spring by different forces (of different magnitudes) acting on it	p-24, p-25, p-28, p-79, p-80
III-4.	Principle of graduating a spring balance	p-26, p-28, p-79, p-80, p-85
III-5	Effect of magnitude, direction and point of application of a force acting on the body	p-23, p-26, p-61
III-6.	Vertical direction and plumb-line	p-28, p-29, p-79, p-80, p-82
III-7.	Composition of the two forces acting in the same line	p-23, p-26 (part), p-41, p-86 (only one shelf)
III-8.	Examples of thrust and pressure	p-49, p-79
III-9.	Dependence of pressure on (i) Thrust and (ii) Supporting area	p-28, p-30, p-86 (only one shelf)

IV MOLECULAR STRUCTURE OF SUBSTANCES

IV-1	Grinding of crystals of suger	Borrow pestle and Mortar and sugar
IV-2	Dissolving powdered sugar in water	p-14, p-15, p-43, p-71 and p-73
IV-3	Observing minute objects under a microscope or a magnifying lens	p-71, borrow microscope from Biology stores
IV-4.	(i) Change of volume on dissolving salt in water, and (ii) Its explanation on the basis of molecular model	p-23, p-36, p-47 p-72, p-73, p-79, p-80
IV-5.	Interaction between two lead cylinders (molecular cohesion)	p-28, p-38, p-39, p-79, p-80
IV-6.	Cohesion between drops of water	p-14, p-24, p-43, p-67, p-73, p-79, p-80, p-81, p-85
IV-7.	Shape of mercury drops	p-40, p-71
IV-8.	Mechanical model of molecular interaction	p-41, (ii), p-25
IV-9.	Forces required to tear apart sheets of paper of different sizes	Some strips of papers of different sizes and thickness
IV-10	Diffusion	p-47, p-73, p-74
IV-11.	Principle for marking fixed points on a thermometer	p-49, p-73, p-77, or p-84, ice, p-79, p-80
IV-12.	Use of thermometer for measuring temperatures.	p-49, p-72, p-73, p-77 or p-84
IV-13.	Taking readings on the model of celsius scale	p-56, p-57, p-58
IV-14.	Expansion of solids on heating	p-14, p-28, p-43, p-45, p,77, or p-84, p-80, p-79, p-82
IV-15.	Expansion of liquids on heating	p-18, p-23, p-72, p-73, p-77 or p-84, p-82
IV-16.	Expansion of gases on heating	p-47, p-72, p-77 or p-84, p-82
IV-17.	Bimetallic strip and its use	p-46, p-77, or p-84, p-79, p-80, p-82
IV-18.	Model of molecular structure of solid, liquid and gaseous forms of a substance	p-36, p-37

V. SOME PROPERTIES OF SOLIDS AND FLUIDS

V-1.	Elastic deformation	p-4, p-20, p-21, p-22, p-25, p-28, p-31, p-32, p-33, p-35, p-79, p-80, p-81
V-2.	Plastic deformation	p-32, p-79, p-80, p-81
V-3	Molecular model of elastic and plastic deformation	p-35, p-36, p-37, tray of p-86
V-4	Breaking a brittle body	Dry wooden stick (p-82) of Glass plate/tube
V-5	Increase of plasticity of a steel wire by heating	p-77, or p-84, p-79, p-82 steel wire
V-6.	Change of gas pressure with change of volume	p-23, p-61, p-83, rod of p-79
V-7.	Increase of gas pressure with increase of temperature	Cleaned empty tin with lid, p-77, p-79 and p-80, p-82
V-8.	Surface of liquids at rest and its relation with vertical direction	p-6, p-14 or p-73, p-79, p-80
V-9.	Construction and use of a simple level	p-29
V-10	Construction and use of a spirit level	p-54
V-11	Interconnected vessels	p-48, p-53, p-79, p-80
V-12	Pascals' law for fluids (i) qualitative idea (ii) quantitative idea	p-50, p-51, p-52, p-74
V-13	Model of hydraulic press	
V-14	Working of air pump	p-20, p-50, p-83

VI. PRESSURE IN FLUIDS

VI-1	Pressure on the base supporting the liquid and its increase with the increasing height of liquid column	p-23 p-61, p-73, p-83 or p-14
VI-2	Pressure at different depths and inside the liquid	p-8, p-55, p-56, p-72, p-73, p-79, p-85, p-72 (Rubber tubing)
VI-3	Pressure on the wall of a vessel	p-42
VI-4	Existence of atmospheric pressure	p-41, p-63
VI-5	Rising of water due to the atmospheric pressure	p-19, p-73
VI-6	Idea about the magnitude of atmospheric pressure with the help of a rubber sucker	p-14, p-28, p-63
VI-7.	Working of a water pump	p-12, p-18
VI-8.	Air has weight	p-2, p-7, p-20, p-50, p-78, p-79, p-80
VI-9.	Measuring magnitude of the buoyant force	p-18, p-26, p-73 or (p-14) a stone pipe
VI-10.	Archimedes' Principle for partly and fully immersed bodies	p-17, p-26, p-65, p-70, p-73, p-78, p-79, p-80
VI-11	Dependence of buoyant force on the volume of the body	p-26, p-69, p-70, p-73, p-79, p-80
VI-12.	Dependence of buoyant force on the relative weight of the liquid.	p-14, p-16, p-26, p-69, p-79, p-80
VI-13.	Floatation of bodies of different substances in a liquid	p-18, p-68, p-72, p-73
VI-14.	Floatation of a body in different liquid	p-18, p-68, p-72, p-73
VI-15.	Demonstration to explain floatation of ship	p-66, p-67, p-73, p-81

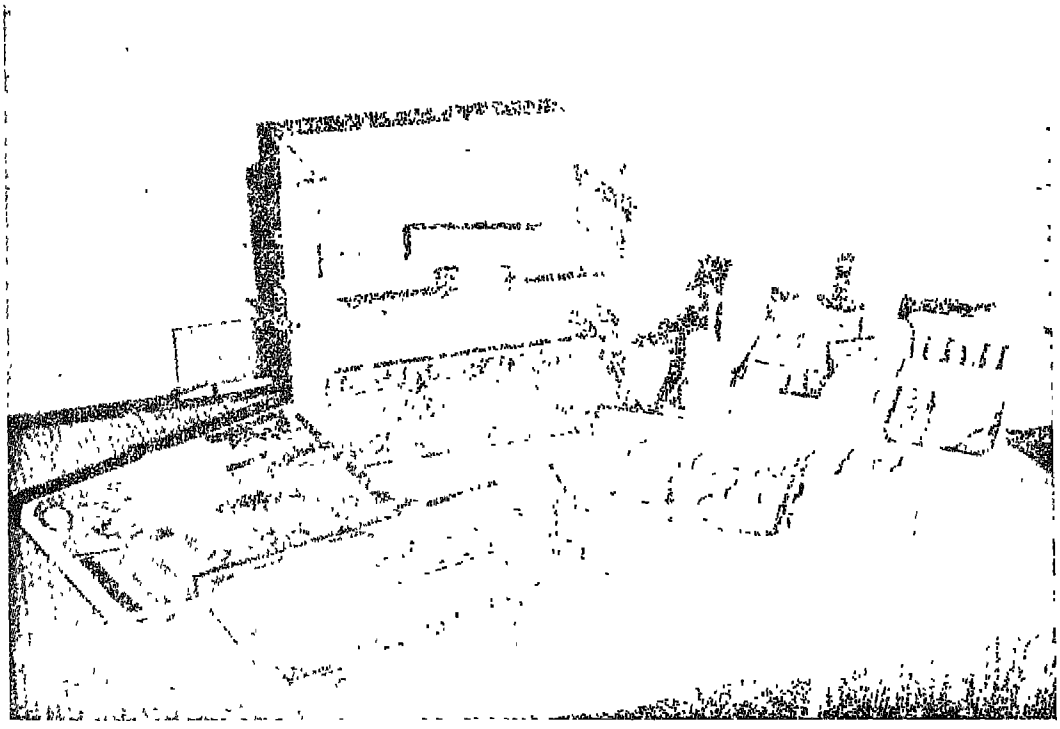
PUPIL EXPERIMENTS

1.	(a) Measuring linear dimensions of a rectangular block	p-5, p-18

	(b) Measuring average thickness of book sheets, or the average diameter of a wire or thread	p-5, p-72
2.	Measuring surface area by using graph paper	p-9, p-10, p-11
3	(a) Measuring volume of an irregular small solid using a graduated test tube or cylinder	p-15, p-17, p-72, p-73, p-85
	(b) Measuring the average volume of water, using a dropper	p-19 (plus item against 3 a)
4	Making a simple spring balance by graduating a spring and using it for measuring the weight of a body	p-12, p-15, p-18, p-27, p-28, p-65, p-73
5.	Studying the expansion of a liquid on heating	p-18, p-47, p-72, p-82, p-84
6	Use of spring and coils for a simple study of plasticity and elasticity	p-9, p-24, p-28, p-33 p-79, p-80
7.	Vertical direction and level surface	p-29, p-54
8.	Study of Archimedes' Principle	p-26 p-65, p-70, p-73, p-78, p-79, p-80
9	A study of the conditions of floatation	p-9, p-72, p-73, p-85

PHYSICS PUPIL'S KIT NO. I

D S.E (C S W) III



This kit provides material for pupil's experiments. It consists of a wooden kit box measuring 480×255×430 mm. with five trays of different sizes. There are twenty-five items but in varying quantities The list of items specifies contents of each of these trays so that after the experiment pupils can themselves put these items back in their places. The kit is meant for a class of 44 pupils who will form groups of two each to perform the experiments

Necessarily, items of this kit have been selected from the list of items of the Physics Demonstration Kit No 1. Most of these items are available in the local markets so that there will not be any difficulty in providing replacements This kit also eliminates storage problem as it can be locked and kept in a corner of the room.

Since this kit is only a supplement to Physics Demonstration Kit No. 1, the books published and list of topics covered are the same. A few examples of improvisation of apparatus are, however, given after the list of items.

List of Items

Tray No. 1

1.	Test tube support (Polythene, for 12 test tubes)	2
2.	Wooden block-*cum*-test tube holder	22
3.	Plastic tumbler (with a pouring beak)	22

Tray No 2

4.	Graph paper (metric, 10 cms —20 cms.)	22 sheets
5.	Rubber band (big)	44
6	Rubber band (small)	44
7.	Toy balloons (small)	88
8.	Polythene bags (100—200)	22
9	Glass marbles (10 mm dia)	132
10.	Cellotape (small)	1 reel
11.	Drawing pins (steel plated)	144
12	Paper clips	100
13	Plasticine	100

Tray No. 3

14.	Bottle (polythene)	22
15.	Polythene tube (transparent, 4 mm. bore×30 cm. long)	22
16.	Polythene tube (transparent, 5 mm bore×10 cm long)	22
17.	Polythene tube in No. 2 cork (transparent, 3 5 mm. bore×15 cm. long)	22
18	Rubber suckers (small)	22

Tray No. 4

19.	Spring balance (Pupils)	22
20.	Compression-*cum*-extension spring	6
21.	Wooden wedge small	66

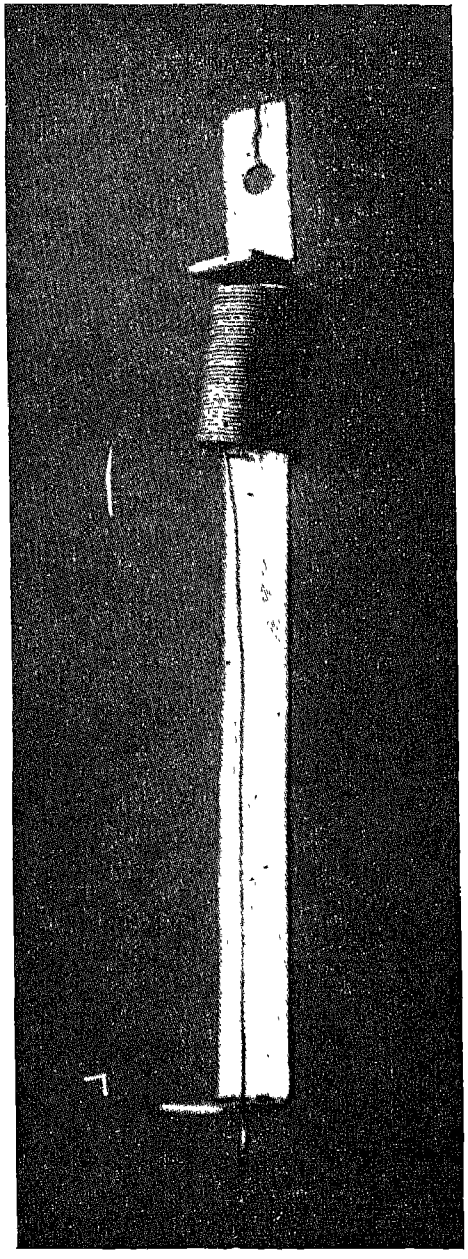
Tray No. 5

22.	Candles	22
23.	Match Box	1 doz.
24	Plastic bevel scale	22
25.	Dropper (polythene)	

The Kit Box

Examples of Improvisation

12. SPRING BALANCE (PUPILS) RANGE 0-100 G. WT. (PAIR) (*P-27*)



Requirements

(i) A simple device for measurement
(ii) Ungraduated
(iii) Inexpensive.

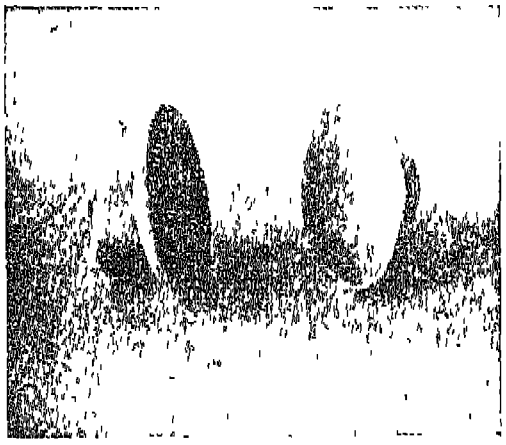
Concepts and Skills

(i) Measurement.
(ii) Caliberation.

The Prototype

The prototype developed fulfils the requirements. It is simple and handy so that pupils can handle without any hesitation. The body and spring are made of mild steel. The spring has been tempered so that it retains elasticity. Space has been provided below where the child can mark graduations by pasting graph paper.

13. Rubber Suckers (*P-63*)



Requirements

(i) A device which could produce vacuum conditions.

(ii) Simple and handy.

(iii) Lasting and inexpensive.

Uses

(i) To illustrate Magdeburg's Hemispheres.

Concepts

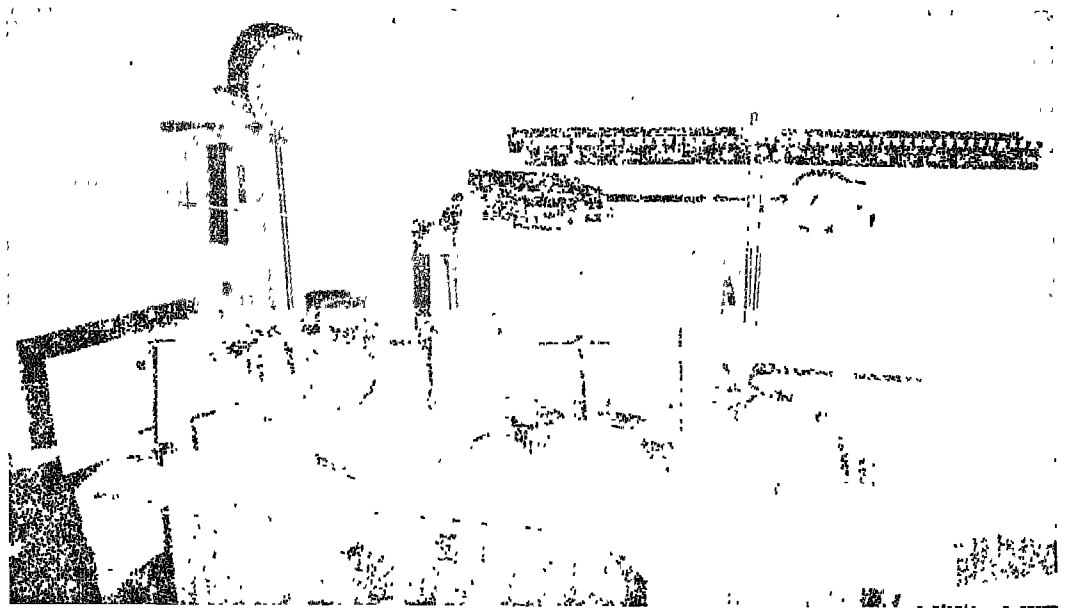
(i) Atmosphere exerts pressure

The Prototype

The prototype consists of a pair of rubber cups with handles generally used for grinding valves in the automobile industry. It is inexpensive, sturdy and simple It provides good vacuum conditions when the two cups are pressed against each other.

PHYSICS DEMONSTRATION KIT NO. II

D.S.E (C.S.W) IV



Physics Demonstration Kit No II is meant for teaching physics to the second year class of the middle stage. Along with the Pupil's Kit No. II, it provides a complete laboratory

Most of the items consist of improvised apparatus but efforts have been made to include whatever items could possibly be purchased from the market. These items are contained in four trays provided in the kit box measuring 530 × 290 × 390 mm., which facilitates their use and return. There are 71 items including the kit box. The box can be locked and stored in a corner of the class room and does not create any storage problem.

NCERT has published a textbook and teacher's guide which are supplemented by this kit for doing laboratory experiments. A kit guide has been prepared which lists out 52 demonstrations/experiments. Here the items have been depicted according to the experiments. This will be more useful for the teacher.

Books Published (NCERT)

(a) Textbook
Physics Part II—Science for middle school
(b) Teacher's Guide for Physics Part II
(c) Kit Guide

Scientific Topics covered under the New Curriculum

(1) Mechanical motion.
(2) Composition of Forces, Equilibrium of bodies
(3) Work and Energy.
(4) Thermal phenomena.
(6) Heat and Work.
(6) Transition of substances from one aggregate state into another.

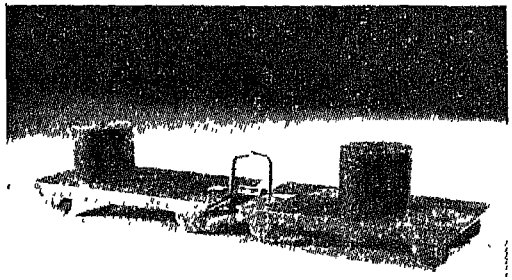
LIST OF ITEMS

Sl No	*Chapter*	*Item*	*Place in kit Tray*
P-101.	General	Laboratory stand with clamp and boss-head	1
P-102	General	Hard Board sheet-*cum*-screen	1
P-103.	General	Stand for Hardboard sheet	2
P-104	General	Paper clips (1 doz.)	1
P-105.	General	Cellotape (1 reel)	1
P-106	1	Polythene tube with two corks and pith ball	4
P-107.	1.2 3	Flags (4 Nos)	4
P-108.	1,2,3	Trolleys (2 Nos.)	2
P-109.	1,2	Catch for trolleys	2
P-110.	1,2	Compression spring, 45 mm long for trolleys	2
P-111.	3	Bolt with fly nut for trolley	2
P-112.	3	Rod with pulley at one end for trolley	2
P-113.	3	Rubber sleeve with thread for trolley	2
P-114.	1	Curved Guide	2
P-115.	1	Steel Ball, 22 mm.	2
P-116.	1	Chalk holders (3 Nos.)	4
P-117.	1	Rubber suckers (2 Nos.)	4
P-118.	1	Clock model	2
P-119.	1,2,3	Weight 100 g. wt. (2 Nos)	4
P-120.	1,2,3	Block of wood with sand paper	2
P-121.	2,3	Roller with hook	2
P-122.	1,2	Small plastic bag	1
P-123.	2,3,5	Beam balance	4
P-124.	2,3,5	Weight box	4
P-125.	2,3	Open type spring balance (2 Nos.)	2
P-126.	2,3	Hollow cylinder	2
P-127.	2	Hammer with detachable head	2
P-128.	2	Bicycle pedal	2
P-129.	2	Bicycle wrench	2
P-130.	2	Syringe and tube	3
P-131.	2	Toy balloons (6 Nos)	1
P-132.	2,3	1 kg. weight with hook (2 Nos.)	2
P-133.	3	Meter scale-*cum*-lever	4
P-134.	3	30 cm ruler-*cum*-lever	4
P-135.	3	Support for the above ruler-*cum*-lever	4
P-136.	3	Pulley with hook (2 Nos.)	2
P-137	3	Maxwell's wheel	2
P-138.	3	Compression spring 85 mm.	2
P-139.	4	Tuning fork	2
P-140.	4	Resonance box for tuning fork	2
P-141.	4	Striker for tuning fork	2
P-142.	1,4	Discs with teeth (2 Nos.)	4
P-143.	4	Rotator for above discs	4
P-144.	4	Metallic strip	4
P-145.	4	Sitar string	4
P-146.	4	Steel wire 5 m. long	4
P-147.	4	Small balls (Ghungru beads) on rubber tubing with pinch-cock	3
P-148.	5,6	Kerosene wick-stove	3

P-149.	5,6	Candle (2 Nos.)	3
P-150.	5,6	Match box	3
P-151	5,6	Thermometer	3
P-152	5,6	Flat bottom flask 500 c c	3
P-153	5,6	Cork with glass tube for above	3
P-154	5,6	Measuring cylinder, 100 c.c. (polythene)	3
P-155	5,6	Test tube corning (2 Nos.)	3
P-156.	5,6	Cork with polythene tube for above	3
P-157.	5,6	Outer vessel of calorimeter	3
P-158.	5,6	Inner vessel of calorimeter	3
P-159.	5,6	Seat for above inner vessel of calorimeter	3
P-160.	5	Iron rod	3
P-161.	5	Aluminium rod	3
P-162	5	Socket for above iron rod and aluminium rod	3
P-163.	5	Glass tube corning	3
P-164.	5	T-strip for above glass tube	3
P-165	5	Thermoscope	3
P-166.	5	Cork and U-tube for above thermoscope	3
P-167.	5	Set of cylinders of equal mass	3
P-168	5	Frame for above set of cylinders	3
P-169	5	Metal box for melting wax	3
P-170.	5	Wax (100 g.)	3
P-171.	—	Kit Box	

Examples of Improvisation

14. TROLLEYS (*Item No. P-108*)



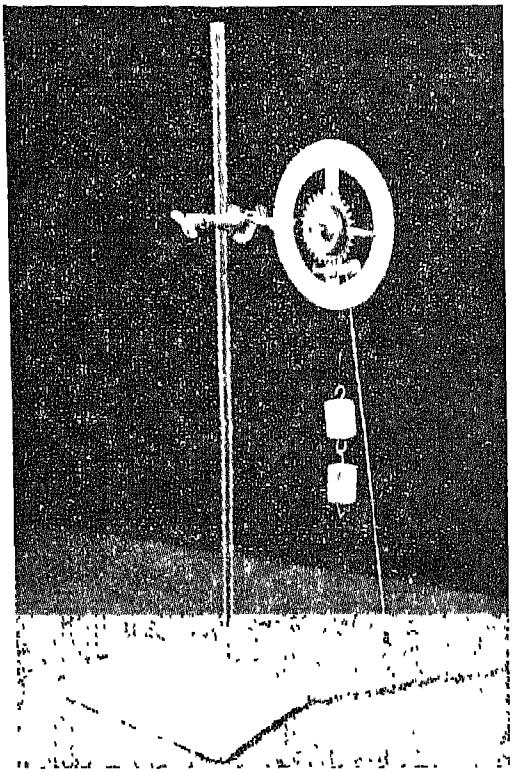
Requirements

This item is for multipurpose use. It is required in a number of experiments on relativity of motion, inertia of rest, inertia of motion, comparing inertial masses of two bodies, potential energy of a lifted body, action and reaction, rotatory and translatory motions etc. According to different requirements the pair of trolleys has to be sturdy sensitive, simple and durable. It should provide frictionless motion as far as possible. At the same time it should not be expensive.

The Prototype

The prototype developed fulfils all the requirements. If properly handled, it should last for a long time. Made out of a thin M.S. Sheet, it has spray paint coating to minimise chances of corrosion. Tapered axle bearings eliminate friction. To make it multipurpose, special shape has been given and the main body carries two holes.

15 A Clock Model (*P-118*)



Requirements

(i) A device for measuring time.

(ii) Its working should be visible to pupils.

(iii) Length of pendulum should be adjustable.

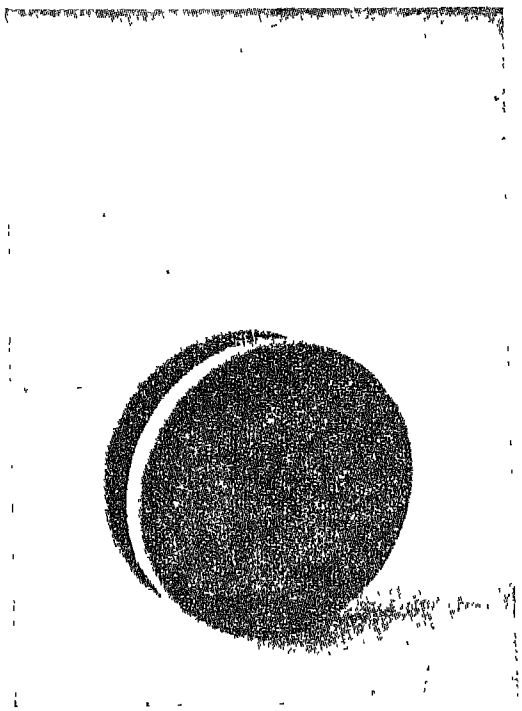
(iv) Simple mechanism but of sturdy construction

(v) Inexpensive but durable.

The Prototype

The improvised model satisfies all the requirements and is ideal for demonstration. Children can see the working of an escapement wheel. The frequency of the oscillation of the pendulum can be adjusted. The construction is simple yet every part is sturdy. On mass scale production, cost can be appreciably reduced If handled properly, it will last long.

16. MAXWELL'S WHEEL (*P-137*)



Requirements

(i) To improvise a substitute for the conventional Maxwell's wheel to demonstrate conversion of potential energy to kinetic energy and *vice-versa*.

(ii) Use of a single suspending thread instead of two.

(iii) Easy to handle, inexpensive and durable.

Availability

No such model available.

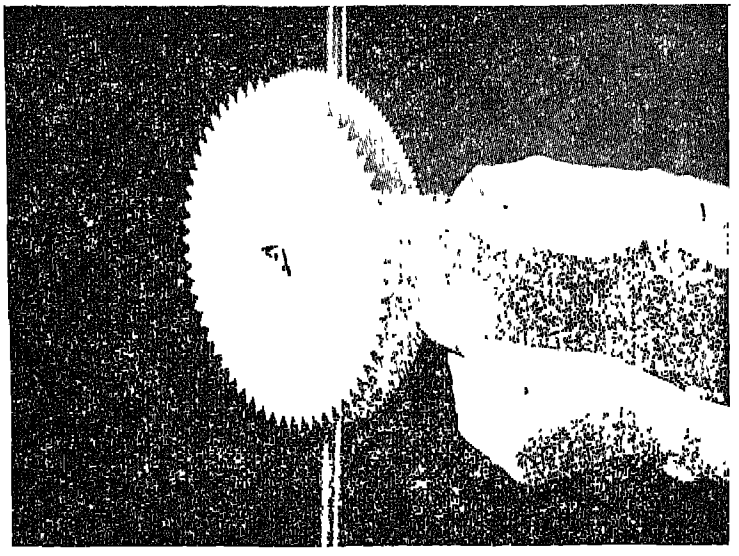
The Prototype

Made out of plastic, it consists of a wheel having a deep groove at the middle. Down where the groove finishes, a hole has been provided so that one end of the thread can be made to pass through this hole and a knot tied. The other end of the thread is either held by the teacher in his hand or fixed to the laboratory stand.

The wheel is rotated so that the thread is wrapped in the groove and the wheel moves up. At the highest position of the wheel it is released. It will be noticed that the wheel continues to come up and go down for some time.

The device is simple, inexpensive and durable.

17. Discs with Teeth and Rotator for Disc and Metallic Strip, (*S. No. 142, 143 and 144*)



Requirements

(i) A device to produce different frequencies of sound with the help of two discs

(ii) To produce different sounds at the same frequency by using different materials.

(iii) To be simple, inexpensive and durable.

Availability

Some devices available but costly.

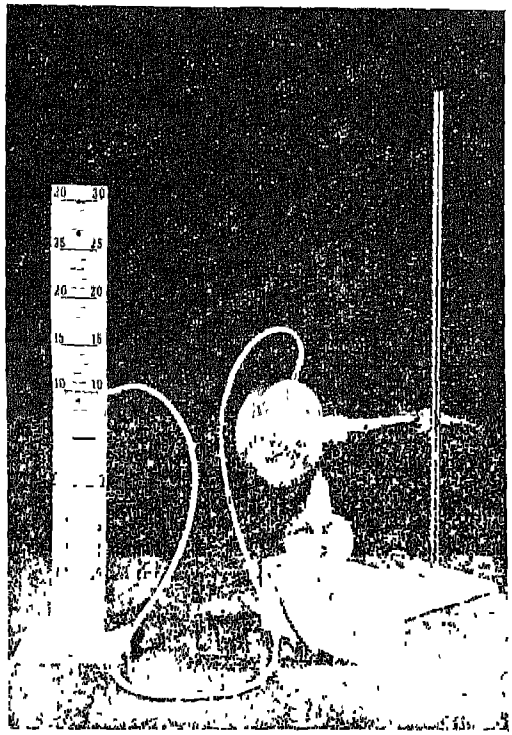
The Prototype

It consists of two discs mounted on a shaft which could be rotated. The discs have different number of teeth, and are made of mild steel or other substances. Although a steel strip is provided, it is recommended that other strips may also be made out of different material like wood, paper, etc.

When one of the discs is rotated, the different strips are made to touch the teeth in the direction of rotation. Thus different sounds will be produced. When both the discs are rotated and their teeth are touched by the same strip, sounds of different frequecies are produced.

The device is simple, inexpensive and durable.

18. THERMOSCOPE (*P-165*)



Requirements

A device required to illustrate thermal phenomena of conduction, radiation and internal energy. It necessiated the provision of a black surface as well as a shining white surface, a sealed container with one outlet for connecting with a manometer for demonstrating change in internal energy.

The Prototype

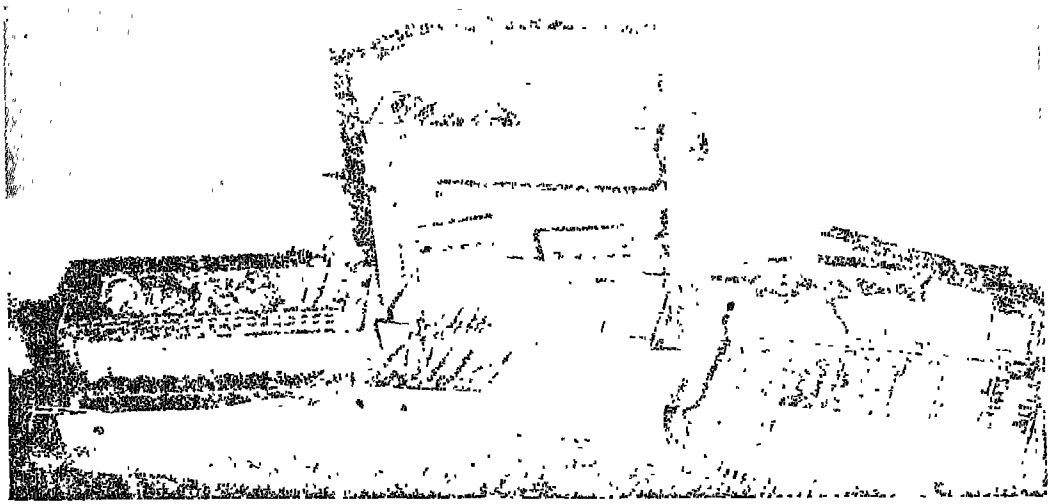
The prototype satisfies all requirements The sides are made of thin brass sheet and the central separating ring of the body is of polysterene plastic. An insulating handle is also provided. The outlet can be connected with a manometer by means of a plastic tube. This apparatus is ideal for demonstration as well as pupil's use. Concepts of radiation, conduction and change of internal energy can be easily demonstrated.

LIST OF ACTIVITIES

1 Relativity of motion
2. Rotatory Motion
3. Translatory motion
4 Oscillatory motion
5 Time period of a simple pendulum
6 Measuring time
7 Uniform motion
8 Measuring speed
9. Inertia of rest
10. Inertia of motion
11. Comparing of inertial masses of two bodies
12 Comparing mass by a beam balance
13 Use of beam balance
14 Density of a substance
15 Study of friction
16 Comparison of sliding and rolling friction
17 Action and reaction
18 Force of reaction
19. Mechanical work
20 Principle of lever
21 Work done using a lever
22 Pulleys
23 Work done using a pulley
24 Inclined plane
25 Kinetic energy
26. Dependence of kinetic energy on speed and mass of a body
27. Potential energy
28 Potential energy of a lifted body
29 Transformation of energy
30. Vibration of a sounding tuning fork
31 Dependence of sound on the extent of vibration
32 Propagation of sound through steel wire
33 Decrease of intensity of sound in rarefied air
34 Relation between pitch of sound and frequency of vibration
35 Increase in internal energy due to the work performed
36. Work performed at the expense of internal energy
37. Transfer of internal energy
38 Conduction of heat in metals
39 Convection currents in air
40 Convection in chimneys
41 Convection currents in liquids
42 Heat conduction in water
43 Heat conduction in air
44 Thermal radiation
45 Measurement of the quantity of heat
46 Mixing of cold and hot water
47 Specific heat
48 Melting of crystalline substances
49 Rate of evaporation increases with open surface area
50 Cooling due to evaporation
51 Boiling
52. Boiling at reduced pressure

PHYSICS PUPIL'S KIT NO. II

D S E (C S W) V



The kit contains material for the pupil's experiments. There are 23 items excluding the kit box, mostly in multiples of 15. It is intended to provide each item for 3 students so that the kit box will cater for a class of 45 pupils. Items have been selected from the list of items of the physics Demonstration Kit No II. Thus, Demonstration Kit along with the Pupil's Kit makes a complete physics laboratory for the second year of the middle school.

The wooden kit box measures 480×257×530 mm. height and has seven compartments consisting of trays which can be pulled out. Height of each tray has been designed according to the items to be kept inside. There are about 400 items in all. Again, there is no storage problem, handling is easy and replenishment of the used and unserviceable items is also within reach of even a rural school. Pupils can perform major experiments.

LIST OF ITEMS

		Qty
Tray No. 1		
1	Weight box for beam balance	15
2.	Pulley with hook	15
Tray No. 2		
3	Two cylinders, one made of steel, another of aluminium of the same volume with narrow bore The steel one weighs 100 gms.	15 pairs
4	Flags	15
5	Steel strip (20×15×200 mm. 26 SWG), to be used as spring	15
6.	Rectangular block made of wood, steel and aluminium (40×30×10 mm) for finding density	15 each
7	Small steel disc (dia. 40×2·5 thick, one face pointed).	15
8.	Thermometer (—10°C —110°C)	15

Tray No 3

9	Beam balance (pans kept in Tray No. 7)	15

Tray No. 4

10.	30 cm ruler-*cum*-lever	15
11.	Support for ruler and pulley	15
12.	(a) Rack for test tubes	15
	(b) Test tubes in (a)	44 (15 of them are half filled with Naphthalene).
13.	Test tube holder	15

Tray No 5

14	Hard board (6 mm thick×450 long)	15
15	Wooden blocks pair each with sand paper and hook, weights—100 gms.	15
16	Sitar wire	15 lengths
17	Adjusting piece	15
18	Plastic tumbler with a beak	15

Tray No 6

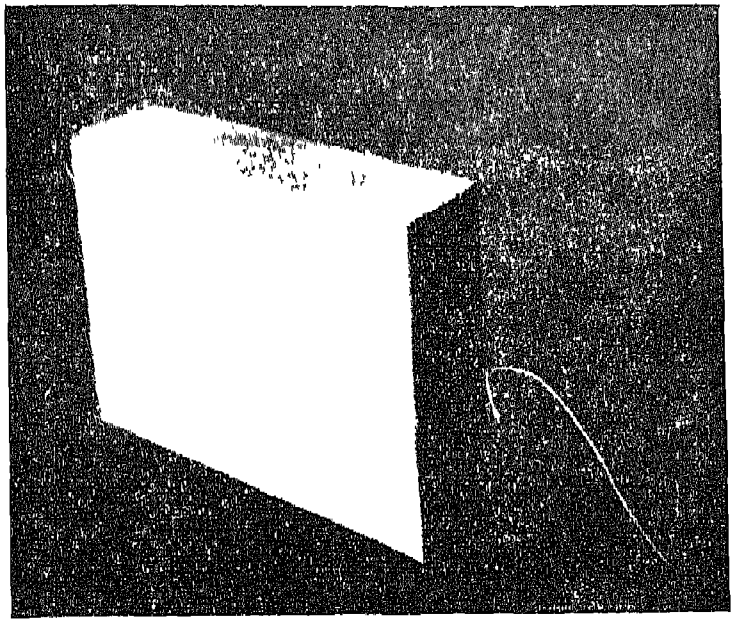
19.	Spring balance (pupils')	30
20.	Measuring cylinder without base (100 c c.)	15
21.	Plastic bag (100×200 mm)	15
22	Polythene tube in No. 2 cork (Transparent, 3 5 mm bore×15 cm long)	15

Tray No 7

23.	Kerosene lamp with chimney.	15
24.	Kit Box	1

Examples of Improvisation

19. Block of wood with sand paper (*P-120*)



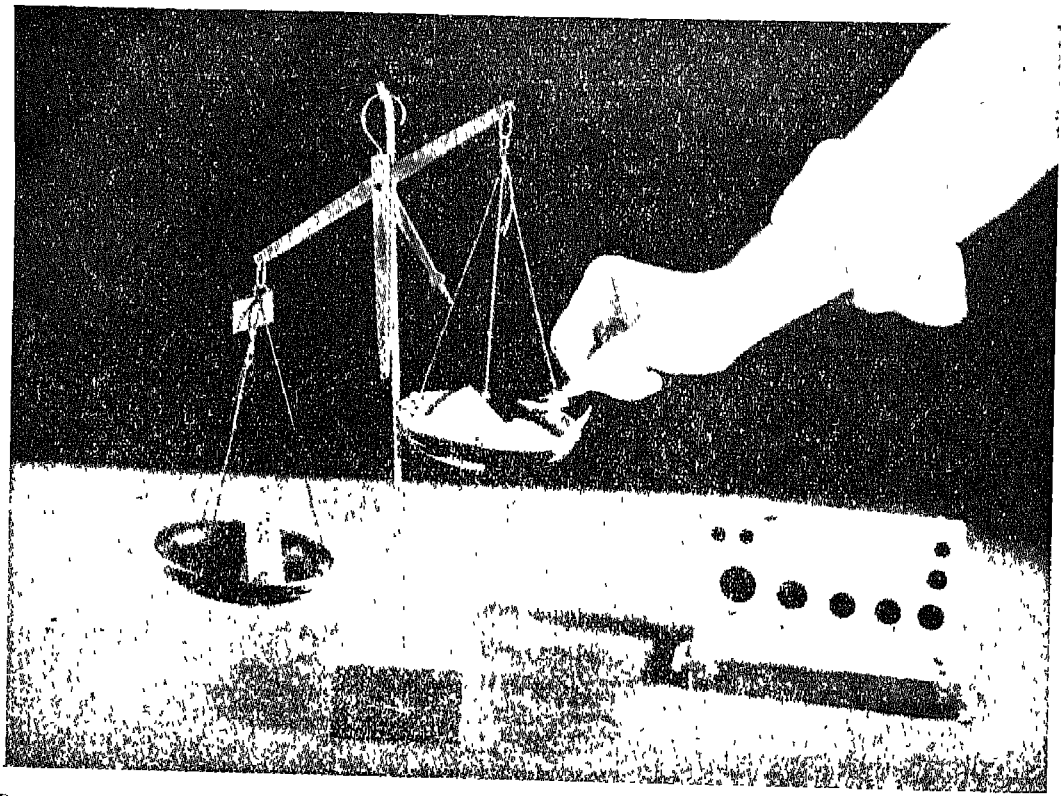
Requirements

A block of wood has multipurpose uses. It is used for showing the inertia of rest and inertia of motion, the dependence of the frictional force on the nature of the surface and complete independence of the frictional force of the surface areas. It is also used as a load in several demonstrations on the kinetic and potential energies. A rough surface was required on one of the faces.

The Prototype

The prototype fulfils all requirements. Approximately of 100 mm. × 60 mm. size, it may have 25 mm. thickness. Made of hardwood, its plain surface is quite smooth. A piece of sand paper is pasted on two surfaces which become rough. A hook is provided for pulling. It is quite inexpensive.

20 BEAM BALANCE (*P-123*)



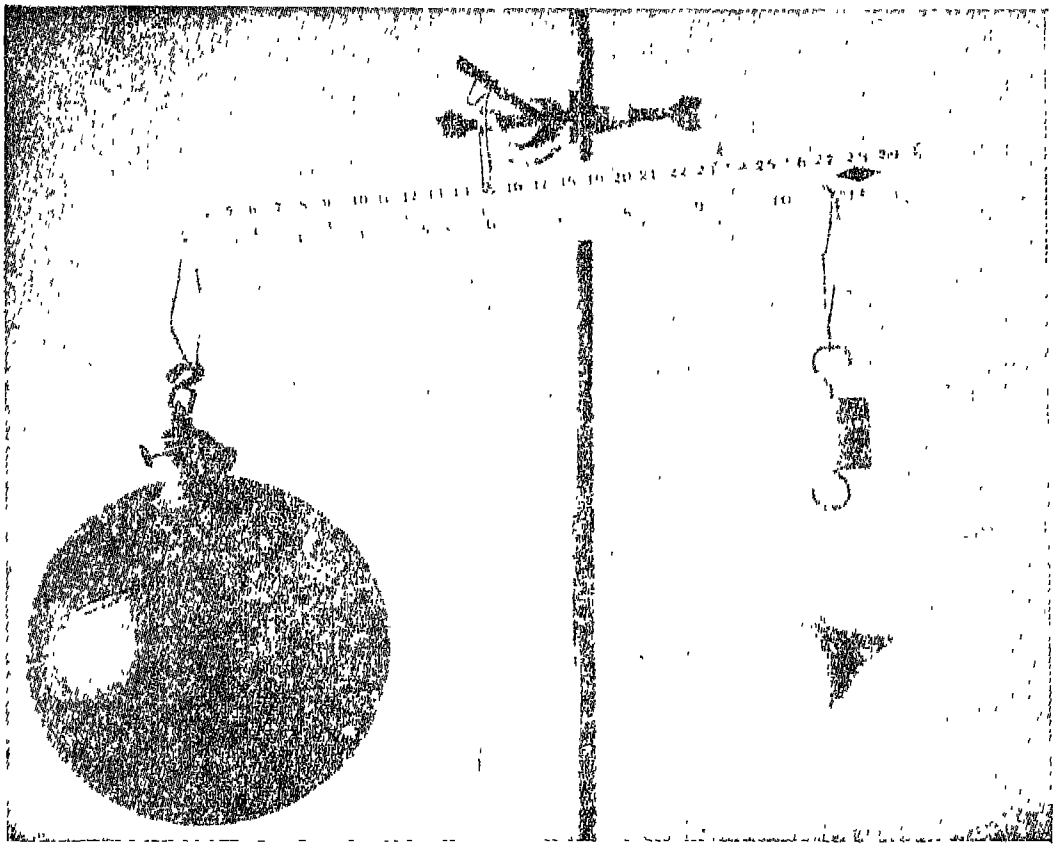
Requirements

The balance is required to provide the concept of measurement of mass to the pupils. It has to be simple so that young children could handle it without any difficulty. It should be sturdy as well as economical. It is required to measure small quantities only.

The Prototype

The prototype satisfies all the requirements. The pans are made from unbreakable plastic. The beam, the pointer and the knife edge pivot are made of mild steel The pans are hung by strong pieces of thread It is advised that for initial balancing, small quantities of plasticine should be stuck on the bottom of the pans The device is simple and effective for rough measurements that the pupils are expected to undertake. A small size weight box with standard weights is supplied along with the beam balance.

21 RULER-CUM LEVER (*S No 134*)



Requirements

(i) A ruler to provide the measurements
(ii) To be used as a lever
(iii) To be simple, inexpensive and durable.

Availability

Available as a ruler only

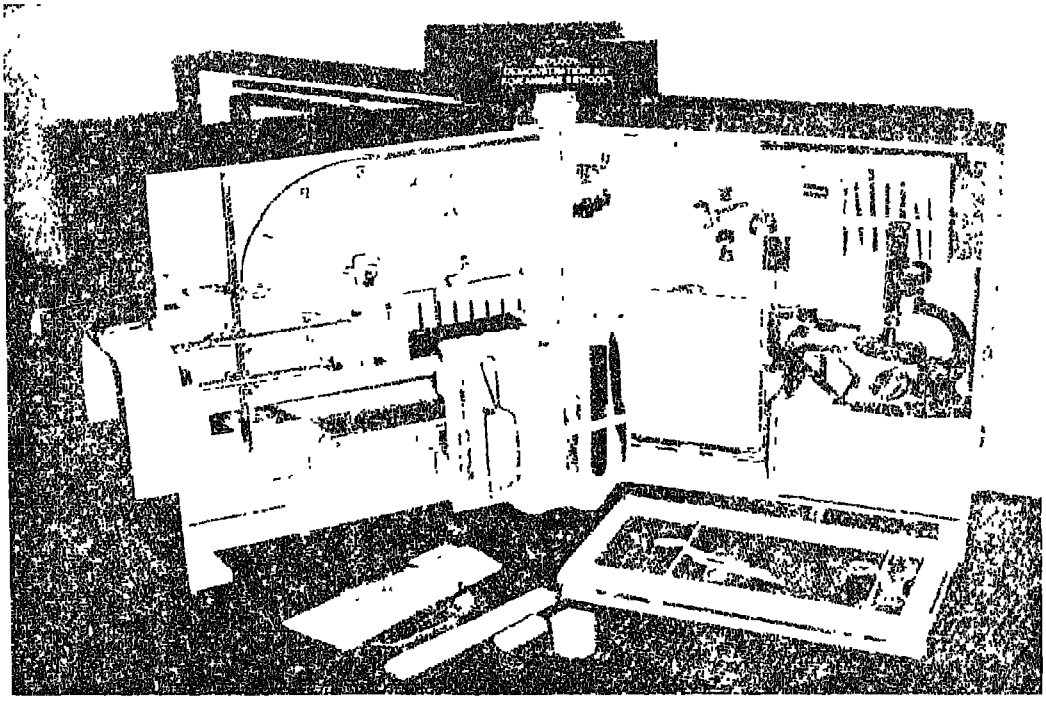
The Prototype

The prototype represents the aluminium ruler with holes provided at the appropriate places Holes have been made for facilitating suspension of hooks (paper clips) while using this as a lever The lever will be in horizontal position only when the moments of forces on either side are equal. Initially to make it horizontal, a piece of plasticine may be attached to the lighter side The lever can also be used as a beam of the simple balance.

It is simple, inexpensive and durable.

BIOLOGY DEMONSTRATION KIT FOR MIDDLE STAGE

D.S E. (C S W) VI



This is a complete composite kit in biology for the three years of the middle stage. Biology, like physics, is introduced in the very first year of the middle school stage. Earlier, for implementation of the Pilot Project in various States, a small kit known as Biology Kit No. I was developed and fabricated to meet the immediate requirements of the first year classes of the experimental schools. Now this kit has become only a part of the main kit under discussion. The first year course of the middle school biology deals with the Plant Life (Botany) the second year with Animal Life (Zoology) and the third year with Human Life (Physiology).

The earlier version of Biology Kit No. I contained improvised apparatus for the study of Plant Life It contained 17 items in all and one of the items, *viz.* the Heliotropic Chamber was also used as a kit box. A list of these items is given below :

B—1. Carrot Osmometer
B—2. Heliotropic Chamber
B—3. Root growth apparatu
B—4 Biological file
B—5. Herbarium press
B—6. Root pressure apparatus
B—7. Iron tripod stand
B—8. Dissecting needles (pair)
B—9. Test tube support
B—10. Seed burning spoon
B—11. Auxonometer
B—12. Microscope (Dynam type)

B—13. Dissecting microscope (box type)
B—14. Hand lens with handle (4 X)
B—15. Folding lens
B—16. Box (with 6 slides and 1 doz cover glasses No. 1)
B—17 Scalpel (Blade 32 mm., metal handle—100 mm. long).

In the main Biology Demonstration Kit for middle stage, some of the above items have been dropped and some others have been modified and the remaining ones kept as such.

This kit is unique in design as it opens up on both sides like the wings of a bird. Thus it provides four sides which are easily accessible for any demonstration. When closed, the kit box measures $600 \times 450 \times 660$ mm. height. Side I contains apparatus for Zoology, side II and III for Physiology and side IV for Botany. The last side also contains General Equipment and Chemicals. Side II and III have a common bottom which also serves as a small storage space for items which could not be accommodated on side walls Side IV carries a small movable partition wall which provides additional area for storage.

Constructed of wood and thick plywood board, the kit box is sturdy and durable. Flaps opening on both sides are provided with small wheels at the bottom for easy handling. Thus sides I and IV will move in and out without much effort. Special fixtures have been provided on the sides to hold specific items. There will not, therefore, be any mix-up once the teacher knows the position of various pieces of equipment. The design of the kit box facilitates handling as the teacher can get the required items for a specific demonstration from the particular side only.

The kit consists of 100 items including the kit box. This serves as a complete laboratory for demonstration and group activities by the students. As in other cases, there is no storage problem for this kit. Most of the items are readily available in the market and replenishment is easy. Some basic hand tools are included so that the teacher can undertake minor repairs himself.

Reference Books Published (NCERT)

(a) *Textbooks*
(i) Biology Part I)
(ii) Biology Part II) Science for middle schools
(iii) Biology Part III)
(b) *Teacher's Guide*
(i) Teacher's Guide for Biology Part I
(ii) Teacher's Guide for Biology Part II
(c) *Kit Guide*

Scientific Topics covered under the New Curriculum

FIRST YEAR.
(1) The importance of plants in nature
(2) Cell: Cellular structure of plants
(3) The seed and its germination
(4) The root Absorption of nutrients from soil
(5) Stem Trasport of substances in the plants
(6) Leaf . Preparation of organic substances
(7) Flower : Reproduction in plants
(8) Plant as living organisms
(9) Diversity of plants

SECOND YEAR:
(1) Introduction to animal life.
(2) Protozoa
(3) Coelenterata
(4) Worms
(5) Molluscas
(6) Arthropoda
(7) Pisces
(8) Amphibians
(9) Reptiles
(10) Birds
(11) Mammals

THIRD YEAR:
(1) Classification and evolution of animals
(2) Introduction to human physiology
(3) General survey of the human body
(4) Organs of movements
(5) Food and digestion
(6) Blood and blood circulation
(7) Respiration
(8) Metabolism
(9) The skin
(10) Nervous system and sense organs
(11) Human development and heredity
(12) Human body as an integrated whole

LIST OF ITEMS

Sr No	*Name of the item*	*Qty*
SIDE I : ZOOLOGY		
1	Insect display case	One
2	Insect cage	One
3	Insect mounting board (adjustable)	One
4	Net for collecting insects	One
	(a) Handle for insect net	One
5	Bottle for chloroform (Coloured glass, 40 mm dia ×100 mm long with stopper)	One
6	Insect killing jar (Glass, 75 mm dia ×120 mm long with stopper and a glass tube)	One
SIDE II PHYSIOLOGY		
7	Thermometer (0 –110°C or —10—100°C' with 1° graduation)	One
8	Pipette (with 5 and 10 ml marks)	One
9.	Glass stirrer (Rod with rubber tubing at the tip)	One
10	Bottle for iodine solution (coloured glass, 25 mm sq.×60 mm long fitted with dropper)	One
11.	Test tube for collecting saliva	One
12	Test tube I for starch (control)	One
13.	Test tube II (for saliva+starch)	One
14	Test tube III (for boiled saliva+starch)	One
15	Test tube IV (saliva+acid+starch)	One
16.	Test tube V (saliva+white of egg)	One
	(Six test tubes, Soda glass, 15 mm dia ×120 mm. long)	
17.	Starch paste bottle (Polythene –50 mm dia ×120 mm. long wide mouth with cap fitted)	One
18	Bottle for glucose—same as Sr No. 17	One
19.	Test tube IA	One
20.	Test tube IIA	One
21.	Test tube IIIA	One
22.	Test tube IVA	One
23.	Test tube VA	One
	(Five test tubes, Soda glass, 15 mm. dia× 120 mm long)	
24.	Bottle for 10% NaOH—same as Sl No. 17	One
25.	Bottle for 0 3 $CuSO_4$—same as Sl. No 17	One
26	Iron tripod	One
27.	Water bath (Aluminium tumbler 75 mm dia ×105 mm long)	One
28.	Wooden discs with holes for support of test tubes and thermometer	One
29.	Kerosene lamp	One
30.	Apparatus to test exhaled and inhaled air	One
31.	Bottle for lime water $Ca(OH_2)$	One
32.	Donder's Chamber (Apparatus to show effect of diaphragm on lungs)	One
33.	Cannule	
SIDE III : PHYSIOLOGY		
34.	Boss heads	Three
35	Clamp with rubber cork	One
36	Beaker 500 ml. (polythene)	One
37	Beaker 150 ml. (polythene)	One
38.	Soft pine board with a hole –25 cm.×9·5 cm.—hole 2 cm dia.	One

39.	Stand for demonstration of muscles contraction (Myoscope)	
	(a) Scale—Semi circular (b) Pointer with a block Auxonometer	One
	(c) Electrodes	One
	(d) Bone holder	One
	(e) Weights (two rubber corks Nos 2 and 8)	One
	(f) Hook for tendon of muscles	One
	(g) Hook for heart	One
40	Bottle for saline solution (0 7% NaCl)—Polythelene 50 mm. dia.×120 mm long	One
41	Induction coil	One
42	Set for ergography	
	(a) Bracket with pulley	
	(b) Pencil holder with pencil	
	(c) Nylon string with hook and loop	
	(d) Platform with guide for paper	
43	Cotton bag for 5 kg. soil	One
44.	Dissecting tray with wax (aluminium)	One

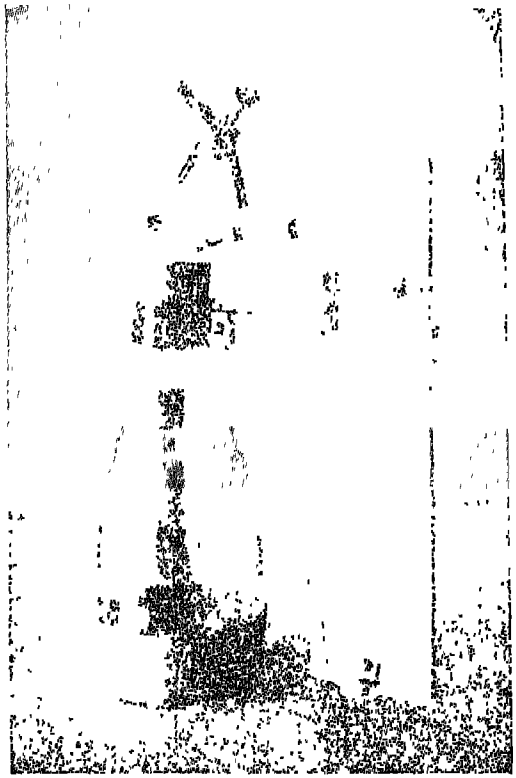
SIDE IV . BOTANY, GENERAL EQUIPMENT AND CHEMICALS

45	Tube and cork for carrot osmometer	
	(a) Glass tube 4 mm bore×370 mm long	One
	(b) Rubber cork 30 mm dia ×45 mm	One
46	Root growth apparatus	One
47	Botanical file (pair)	One
48.	Botanical press (pair)	One
49.	Test tube stand	One
50.	Seed burning spoon	One
51	Dissecting microscope	One
52	Slide box (with 20 slides and 20 cover glasses)	One
53	Apparatus for respiration of seeds	One
54	Apparatus for transpiration	One
55.	Capillary glass tubes, outside dia 5 mm	
	(a) Length 185 mm. bore 4 mm.	One
	(b) Length 185 mm bore 2 6 mm	One
	(c) Length 185 mm. bore 2 mm.	One
	(d) Length 185 mm. bore 1 2 mm.	One
	(e) Polythene thick tube dia. 15 mm ×115 mm long	One
	(f) Stand for the above	One
56.	Soil sample tubes	3 Nos
57	Petri dish (Plastic, 115 mm dia. × 30 mm. high)	One
58.	Test tube holder	One
59	Triangular file 130 mm.	One
60	Garden trowel 230 mm.	One
61.	Pruning knife 220 mm.	One
62.	Secateur 180 mm.	One
63.	Fret saw 165 mm.	One
64.	Dissecting set	One set
	(a) Scissors surgical 125 mm.	One
	(b) Scissors fine point 110 mm.	One
	(c) Forceps straight (pointed) 120 mm.	One
	(d) Forceps straight (blunt) 130 mm	One
	(e) Dissecting scalpel 50 mm blade	One

	(f) Dissecting needles	Two
	(g) Blunt probe 120 mm.	One
65.	Syringe (plastic 2 c c)	One
66.	Needle for syringe (No. 18)	One
67.	Measuring compass (Divider)	One
68.	Dropper (plastic)	One
69.	Razor blade	One
70.	Marker for roots	One
71.	Ruler (plastic 30 cms.)	One
72.	Container for NaOH (Chemical proof transparent plastic, 25 mm. dia. × 80 mm long with cap. cylindrical)	One
73.	Container $CuSO_4$ Chemical proof transparent plastic, 25 mm. dia × 80 mm. long with cap. cylindrical)	One
74	Container for pins, threads -do- (a) Pins, (b) Threads, (c) Hooks (d) Sewing needle	One
75.	Container adrenalin -do-	One
76.	Container litmus (Chemical proof transparent plastic, 25 mm dia × 80 mm long with cap. cylindrical)	One
77	Container for glucose -do-	One
78	Container for starch -do-	One
79.	Container for $CaCl_2$ -do-	One
80.	Container for Citric acid -do- or Sodium, Aluminium or Potassium Oxalate	One
81.	Container for NaCl -do-	One
82.	Bottle for HCl Conc (Plastic, acid proof, 50 mm dia × 120 mm. long with cap.)	One
83.	Bottle for H_2SO_4 Conc. -do-	One
84.	Bottle for HNO_3 Conc. -do-	One
85.	Bottle for spirit -do-	One
86.	Reagent bottle for 10% HCl—same as Sr. No. 17	One
87.	Reagent bottle for 0 5 % H_2SO_4 -do-	One
88.	Reagent bottle for 20% HNO_3 -do-	One
89.	Reagent bottle for $CaCl_2$ -do-	One
90.	Container for CaO -do-	One
91.	Splints for legs	One pair
92.	Splints for arm	One pair
93.	Tourniquet (plastic and rubber)	One
94	Bandages—85 mm. wide	One roll
95.	Cotton wool, surgical	One oz
96.	Muslin cloth 25 cms. 1 metre	One piece
97.	Blotting paper	One sheet
98.	Heliotropic Chamber	One
99.	Support for bottles (at S. No 80-85 inside the heliotropic chamber)	One
100.	Kit Box	One

Examples of Improvisation

22 —DONDER'S CHAMBER (*S. No. 32*)



Requirements

(i) Improvisation of conventional Donder's Chamber to illustrate breathing movement in human beings.

(ii) It should be a simple device and big enough for observation by young children.

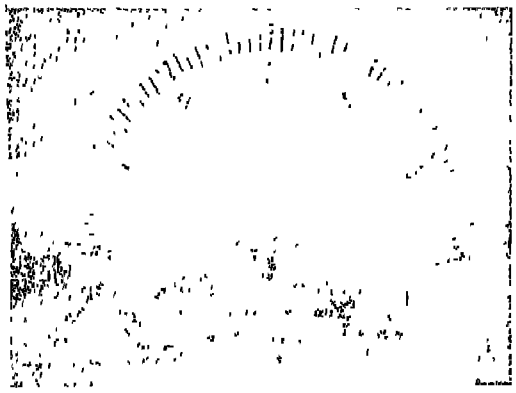
(iii) There should not be any difficulty in replacing the parts even in rural areas.

(iv) Should be inexpensive.

The Prototype

The prototype fulfils all the requirements. Made out of readily available material in the market, it will not create any problems of replacement. Even the complete prototype can be made by the teacher. It is very in expensive and serves the purpose well.

23—Myoscope (*S No 39*)



Requirements

(i) A device to measure the contraction of muscle during reflex.

(ii) A source to provide electric shock.

(iii) A scale to indicate deflection.

(iv) The device should be as simple as possible and large enough for class demonstration.

(v) If possible, it may be used in several other experiments to reduce the cost

The Prototype

The prototype fulfils all the conditions. It utilizes the scale of the auxonometer and induction coil so as to reduce its cost The device is simple so that the pupils can understand its working and the movement of the pointer on the scale can be noticed from a distance.

24—Set for Ergography (*S. No 42*)

Requirements

(i) A device to indicate the muscle fatigue

(ii) It should be simple and sturdy

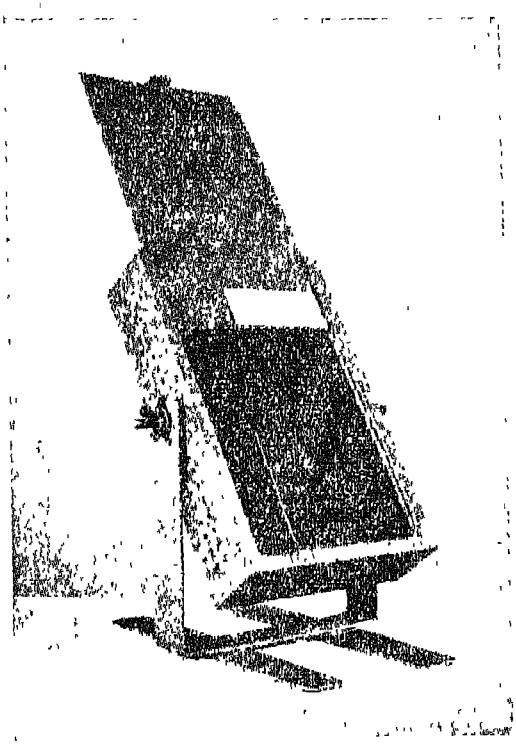
(iii) It should be flexible to measure fatigue of the muscle of a strong as well weak pupil.

(iv) It should be inexpensive.

The Prototype

The device fulfils all the requirements. It is simple and demonstrative. One bag after the other of the sand bags can be added upto a weight of 5kg. and thus pupils of different physique can perform the experiment. The movement of lead pencil will provide clear indication of the fatigue undergone by the muscle. It is sturdy and inexpensive.

25—Root Growth Apparatus (*S. No 46*)



Requirements

(i) A device to illustrate the growth of roots

(ii) The growth should be visible

(iii) It should indicate the direction of growth and effects of various factors

(iv) Should be simple and sturdy.

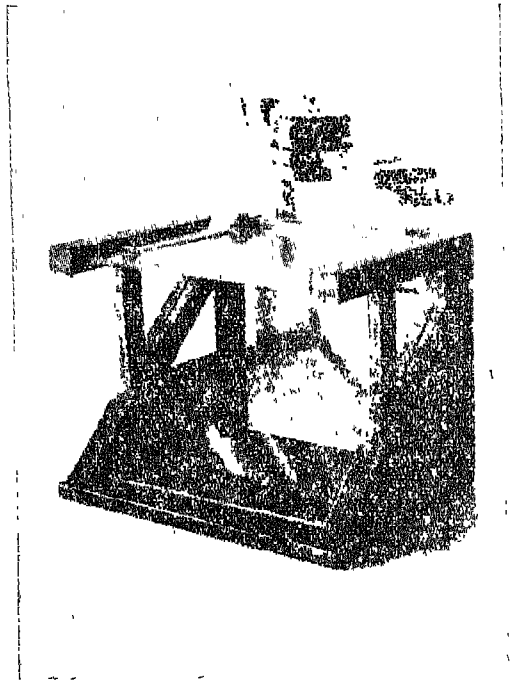
(v) It should be inexpensive.

The Prototype

It fulfils all the requirements. The container has a glass surface and a metallic cover. It can rotate around the horizontal axis to provide various angular positions. Container can store sand and preserve moisture in any position. It is portable and the glass surface can be exposed to light

The growth of roots and its direction are easily observed. The effect of moisture is also clearly noticed. The device is simple, sturdy and inexpensive.

26—Dissecting Microscope (*S. No. 51*)



Requirements

(i) A simple sturdy and inexpensive model of a microscope with a platform to perform dissection
(ii) Total magnification of 20 × with adjustment to indicate 10 × magnification as well
(iii) Easy to handle.

The Prototype

Made of plastic body, it has two lenses which can be taken out easily. For focussing, it can be adjusted with a small force by lifting or lowering these lenses whose support slides tightly inside a sleeve. There is a small platform with holding device so that both hands of the pupil are free to perform dissection. It is so inexpensive that every school can easily afford to have a few sets for pupil's use.

BIOLOGY PART I—BOTANY

Sr. No. *Demonstration*

1. Study of parts of a flowering plant
2. Study parts of a flower
3. Preparation of herbarium specimens of different types of plants
4. Examination of cells by the hand lens and by means of dissecting microscope

5 Study of the parts of a microscope. Rules of handling a microscope

N B The microscope is not supplied in the kit But it should be borrowed from the Senior High School or a neighbouring school

6 Preparation of a temporary wet mount of onion peel and examining the same under the microscope

7. Examination of soaked seeds of bean and maize

8. Composition of seeds Detection of water in seeds

9 Detection of mineral substance By burning seeds in the metal spoon and obtaining the ash

10 Detection of starch
Starch test
(a) in the seed
(b) in flour (muslin bag expt)

11 Detection of protein (product obtained from expt 10 (above)

12 Detection of oil By scratching or pressing seeds on paper

13 Experiments to demonstrate that germinating seeds respire
(a) Germinating seeds produce CO_2
(b) Germination seeds produce heat

14 Demonstration experiment to show the conditions necessary for germination
(a) role of water
(b) role of air

15 Preparation of herbarium specimens of different stages of seed germination
(a) for a dicot seed (bean)
(b) for a monocot seed (maize)

16. Germination of dicot seed and monocot seed in root growth apparatus (for comparison)

17. Germination of seeds at different depths

18 Effect of removal of parts of cotyledons on growth of seedlings

19. Demonstration of different kinds of soil
(a) sandy soil
(b) clayey soil
(c) loamy soil

20. Detection of organic substance in soil

21. Detection of moisture

22. Detection of air in soil

23 Demonstration of mineral substances in soil

24 Separation of sand and clay from soil (in test tubes)

25 Demonstration of the rate of penetration of water in different types of soil (3 test tubes and muslin cloth)

26 Demonstration of rise of water in soil Experiment with capillary tubes

27 Demonstration of different types of root systems.
(a) fibrous root system
(b) tap root system

28 Demonstration of effect of cutting the tip of root on the growth of lateral roots

29 Demonstration to show different zones of growth at the root tip

30 Experiment to demonstrate structure of root hairs, root cap, etc

31 Demonstration of internal structure of roots (no details)

32 Demonstration of absorption of water by roots

33 Demonstration of absorption of water by roots Experiment with a carrot osmometer

34 Demonstration of root pressure

35 Experiment to demonstrate the effect of fertilizers on seedlings

36. Demonstration of structure of bud with a lens

37 Experiment to demonstrate zones of growth at the stem tip

38 Demonstration of internal structure of stem (no details)

39 Demonstration experiment showing transport of substances in a balsam

40 Demonstration experiment to show the effect of light on the growth of stem tip

41 Study of annular rings in a cut section of stems (timber or logs)

42 Study of underground stems, modified for different functions

43. Demonstration of internal structure of leaf (no details)

44. Demonstration of presence of stomata in leaves Forcing air by pressure into the petiole by means of a pump (supplied with primary science kit)

45. Demonstration of chloroplast in leaf cells (through microscope)

46 Extraction of chlorophyll from leaves

47. Functions of leaves · photosynthesis
(i) Formation of starch in the presence of light
(ii) Evolution of O_2 during photosynthesis (funnel and test tube experiment)

48. Demonstration of transpiration (improvised potometer in the kit) Repeat experiment 26 to show capillary action in the rise of water in stems)

49. Study of structure of flowers

50. Demonstration of the technique of pollination (transferring pollen by artificial methods)

51 Demonstration of grafting
(i) Simple grafting

(ii) bud grafting (use of tools)

52 Demonstration of vegetative propagation
(a) cutting, etc
(b) use of trowel

BIOLOGY PART II - ZOOLOGY

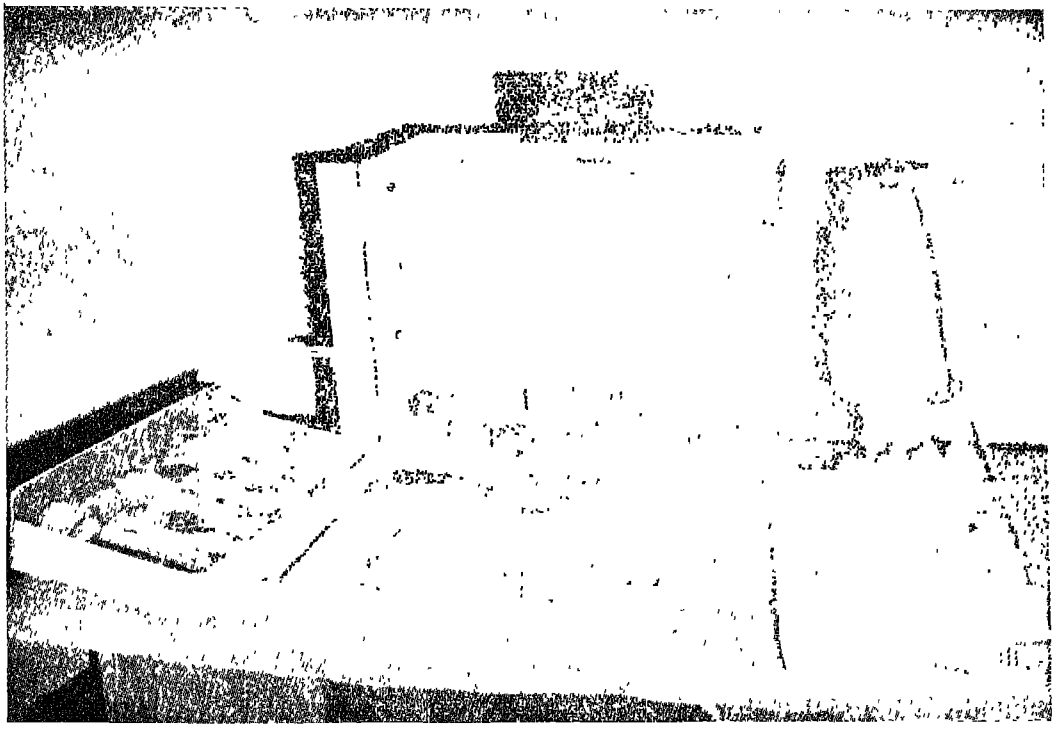
53. Study of living protozoa (*Amoeba* and *Paramecium*). Their structure and their life activities
54. Study of living *Hydra*
55. Study of the external features of earthworms
56 Examination of external features of cockroaches
57 Dissection of cockroach to show the gross internal structure
58 Demonstration of reproduction and development of insects
59 Observation of insects in the field and their collection, preservation, drying and display
60 Study of the external structure of fish
61 Examination of external features of frog
62 Demonstration of internal organs in a dissected frog
63 Examination of the external features of a house lizard
64. Study of the external features of a pigeon with reference to its adaptations
65. Study of internal structure of pigeon in a dissected specimen (parts only)
66 Examination of the structure of an egg (hen's egg)
67. Examination of the external features of rabbit or rat
68. Demonstration of the internal organs in a dissected rabbit or rat

BIOLOGY PART III—HUMAN PHYSIOLOGY

69. Demonstration of the cells of the epithelium of the mouth cavity of man under the microscope
70. Examination of connective tissue
71. Examination of striated tissue in smooth muscle
72. Demonstration of the properties of nervous tissue
73 Demonstration of reflexes in frog
74 Demonstration of the different elements which take part in a relex arc
75. Demonstration of the structure and chemical composition of bones
76. Demonstration of the structure of joints (different types)
77 Demonstration of first aid in case of fractures and dislocation of bones
78 Structure and properties of skeletal muscles Control of muscles by nerves
79. Demonstration of muscle fatigue
80. Demonstration of the action of saliva on starch
81 Demonstration of the action of gastric juice on protein
82 Experiment to demonstrate absorption, as an active physiological process
83. Demonstration of composition of blood (separation in test tube with anticoagulant)
84 Demonstration of coagulation of blood
85 Examination of blood under the microscope
(i) human blood
(ii) frog's blood
86 Demonstration of circulation of blood in the web of frog's foot
87 Demonstration of the structure of the heart of sheep
88 Demonstration of the working of the heart
89 Demonstration of the effect of adrenaline and nicotine on the working of the heart
90. Demonstration of the arterial and venous system in rabbit or rat (injected and dissected specimens)
91. Demonstration of first aid during haemorrhage
92 Demonstration of respiratory organs of frog
93 Demonstration of the relative content of CO_2 in inhaled and exhaled air
94 Demonstration of the mechanism of inspiration and expiration with the help of
(a) rubber balloons in a bell jar
(b) with freshly dissected lungs from a frog (Donder's Chamber)
95 Examination of dissected kidney of a mammal
96 Examination of slides of the skin of frog
97 Demonstration of the nervous system in dissected mammal (rat or rabbit)
98 Demonstration of the spinal reflexes of frog (decapitated earlier)
99. Inhibition of reflexes in frog
100 Study of the eye of sheep or frog
101. Demonstration to identify the distribution of density of receptors
102 Demonstration of the formation and inhibition of pupillary reflexes in man
103 Demonstration of frog's eggs
104 Demonstration of chick's embryo in the egg

CHEMISTRY DEMONSTRATION KIT FOR MIDDLE STAGE

D S.E (C S W) VII



For the teaching of chemistry at the middle school level, a chemistry demonstration kit has been designed and developed This is in fact a 'mini laboratory' consisting of glass apparatus, chemicals, containers and devices for performing demonstrations and experiments. All these items of equipment are packed in a cabinet which forms a compact portable box and can be used in any classroom. The kit would enable not only most of the classroom demonstrations to be performed as are included in the syllabus, but would also help in co-curricular activities in the school.

This demonstration kit includes some common glassware, general equipment, set of tools, chemicals and some improvised apparatus. The selection of equipment of the kit has been made in such a way that about 80 to 90 per cent of all the experiments of any chemistry course at the middle stage can be demonstrated. The liquid chemicals have not been supplied and have to be arranged locally Containers for such items have been included. While developing the kit, special attention has been paid to design new experiments and use equipment made from simple indigenous materials. A number of conventional apparatus have been replaced by improvised ones.

The kit box measures 620 mm. × 320 mm. × 600 mm. height and has been made out of

wood, ply and hardboard There are four compartments from top to bottom. The first three consist of trays which can be pulled out and the last one is a lid hinged at the bottom. The trays contain glassware and chemicals and the bottom compartment provides storage space for general items like gas collecting device, laboratory stand, various holders and fixtures, weighing balance, pump, rubberware, etc. The inside surface of the lid has been utilised to hold some of the equipment.

The kit is supplemented by a Pupil's Kit with which a group of students can perform individual experiments. Thus for a middle school a set of one demonstration kit and five pupil's kits will provide a complete laboratory.

A kit guide has been specially prepared and is sent along with the kit so that the teacher becomes familiar with the items of the kit and also knows how to use the items in various activities. To help the teacher, instructions on the preparation of solutions and safety precautions have been specially dealt with. In addition, a special chapter has been devoted to indicate the necessity of first aid box and instructions for providing first aid in case of accidents or mishaps in a chemistry class. Illustrations of some of the assemblies and experiments are also given at appropriate places.

Reference Books Published by NCERT

I. *Textbooks*
   1. Chemistry Part I
      Science for Middle Schools
   2. Chemistry Part II
      Science for Middle Schools

II *Teacher's Guides*
   1. Teacher's Guide for Chemistry Part I
   2. Teacher's Guide for Chemistry Part II

III *Kit Guide*

   Kit Guide for Chemistry Demonstration Kit for Middle Schools.

IV *Pamphlets*
   1. Experimental methods of teaching chemistry
   2. Some suggested improvisations for chemistry experiments
   3. General techniques of performing experiments in chemistry
   4. Techniques and methodology in preparing chemistry experiments

Scientific Topics covered under the New Curriculum

FIRST YEAR

1. Substances and the changes that take place in them
2. Structure and composition of substances
3. Oxygen, Air
4. Hydrogen
5. Water and solutions
6. Oxides, Bases, Acids and Salts.

SECOND YEAR

1. Important Classes of Inorganic Compounds
2. Chemistry in Agriculture
3. Carbon and its Compounds
4. Metals
5. Importance of Chemistry in National Economy—Development of Chemical Industry in India.

LIST OF ITEMS

Sr. No.	*Name of the item*	*Detail Description*	*Qty.*
1	Kerosene Lamp	(a) Ink Bottle (b) Wick Holder with 3 Clamps (c) Perforated Chimney (tin sheet)	1
2.	Petrol Gas Generator	(a) Bunsen Burner (b) Reagent Bottle (500 ml. wide mouth) (c) Football Bladder No 5	1

3	Laboratory Stand	(a) Clamp Holder (boss-head) (b) Clamp Extension (c) Ring Extension (d) Base (e) Rod	1
4	Tripod Stand	Triangular type	1
5.	Test tube Stand	Polythene for six test tubes	1
6	Test tube Holder		1
7	Balance	10 mg to 100 g	1
8	Weight Box		1
9	Measuring Cylinder, Soda Glass	100 ml with 1 ml. graduation	1
10	Measuring Cylinder, Soda Glass	25 ml. with 1 ml graduation	1
11.	Pipette, Mohr's type, Soda Glass	10 ml., one mark	1
12.	Dropper	Polythene, as per sample	1
13	Burette, Soda Glass	25 ml., 0 1 ml graduation	1
14	Thermometer	—10° to 110°C, graduation 1°C with plastic cover	1
15.	Volumetric Flask with ground Glass Stopper, Soda Glass	100 ml with one mark	1
16	Gasometer with Gas	(a) Tin Can (5 litre) (b) Tin Can (3 litre) (c) Nozzles	1
17	Kipps' Apparatus	Reagent Bottle, 125 ml. wide mouth	1
18.	Liebegs Condenser	Soda Glass Pipe Tube, 2 5 cm dia × 33 cm long	1
19	Voltameter/Bell-Jar Holder	Glass Reagent Bottle wide mouth without bottom (transparent), 10 cm dia. × 12 cm long	1
		Carbon electrodes 7 mm. dia × 60 mm long (2 Nos) Plastic coated ½ metre long wires with crocodile clips at one end and banana plug at other end (2 sets)	2 sets
20	Cork Borer (Set of six borers)	Standard	1 set
21	Triangular File with wooden handle	6″ long	1
22	Triangular Clay Pipe	Standard	1
23	Spatula	Standard (Plastic or Horn)	1
24.	Spoons (a) Size of half tea spoon (b) Size of three tea spoon	Plastic	1 each
25	Test Tube Brush	Standard (Brush is made of plastic)	1
26	Pinch Cock (Clamp) (a) Mohr's type (b) Screw type	 Standard -do-	 2 2
27	Knife/Sharpened Hacksaw Blade, 100 mm long	As per sample	1
28	Deflagrating Spoon		2
29.	Holder for 3 Dry Cells	(a) Holder (b) Plastic coated wires ½ metre long with two banana plugs at the ends	2

30.	Pair of Tongs	16 cms. long	1
31	Scissors (blunt)	14 cms long	1
32.	Wire Gauze with Asbestos in the Centre	10 cm × 10 cm.	2
33	Blow Pipe	Metallic (26 cm long)	1
34	Test Tube	Soda Glass (13 cm × 1·7 cm) One with a hole at the bottom	18
35.	Long Test Tube	Hard Glass (13·5 cms × 2 cm)	2
36.	Boiling Tubes	Hard Glass (15 cm × 2·5 cm)	6
37	Beakers	(a) 100 Ml	1
		(b) 250 ml.	1
38.	Conical Flask, Soda Glass	150 ml	1
39	Funnel	Soda Glass dia. 7·5 cms, 60° stem	1
40	Watch Glass	(a) 5 cms dia	1
		(b) 7·5 cms dia.	1
41	Set of Delivery Tubes 6 mm dia outside, Soda Glass	(a) 45° 3 × 4 cm	2
		(b) 90° 3 × 4 cm	6
		(c) 90° 3 × 17 cm	2
		(d) 90° 4 × 17cm (with a jet at longer tube)	1
		(e) 120° 3 × 4 cm.	3
		(f) U type 2·5 cm each arm	2
		(g) 90° 4 × 5·5 cm	1
		(h) 90° 12×20 cm	1
42	Glass Rod	15 cms long, 6 mm dia	2
43	Set of Glass Tubing	(a) Glass Tubing 11 cm long (dia outer 6 mm)	3
		(b) Glass Tubing with Jet 17 mm. (dia. outer 6 mm)	1
		(c) Glass Tubing 14 cm (dia outer 6 mm)	2
		(d) Glass Tubing 7 cm (dia. outer 6 mm.)	3
		(e) Glass Tubing with jet 5 cm. (dia outer 6 mm)	3
		(f) Glass Tubing 30 cm. (dia. outer 6 mm.)	2
		(g) Glass Tubing 6 cm long (outer dia 8 mm)	2
		(h) 42 cm. long (6 mm. dia.)	1
		(i) 6 cm long with copper coil inside	1
44.	Rubber Tubing	(a) Two metre (dia 6 mm. outside)	1
		(b) 1·1 metre (dia. 10 mm. outside)	1
		(c) 2·5 cm (dia 6 mm. outside)	25
		(d) 2·5 cm. (dia 8 mm outside)	1
		(e) 7 cm (dia. 8 mm outside)	1
		(f) 5 cm (dia. 8 mm outside)	1
		(g) 60 cm (dia. 8 mm. outside)	1
		(h) 25 cm. (dia 6 mm outer)	1
		(i) 3 metre (dia 6 mm outside)	1
45.	Trough (Polythene)	15 cm dia × 7 cm.	1
46	China Dish	10 cm. diameter	1
47.	Pestle and Mortar	Pestle 5 cm dia	1
		Mortar 8 cm. length 1·25 cm. dia.	1

48	Gas Jars (Glass) with three discs	450 ml	2
49	Glass Plate	7·5 cm ×2·5 cm	4
50	Hard Glass Pipe Tube (Both sides open)	12 cm ×2 cm	1
51	Round Bottom Flask, Corning	(a) 500 ml	1
52	Flat Bottom Flask, Corning	(a) 500 ml.	1
		(b) 100 ml.	1
53	Rubber Stoppers	(a) No 16×with two holes (for 6 mm tube)	1
		(b) No 16×with two holes (for carbon electrodes)	1
		(c) No 16×with a small hole for deflagrating spoon	1
		(d) No 13 with a hole in the centre for introducing test tube	1
		(e) No 6 with a hole in the centre (for glass tubing)	2
		(f) No 6 with two holes (6 mm. dia.)	4
		(g) No 2 with one hole (for 6 mm. tube)	1
		(h) No 2 without hole	1
		(i) No 4 with one hole (for 6 mm tube)	2
		(j) Cork for 125 ml wide mouth bottle	1
54	Rubber Ring	Dia 2 cm with a hole (for 6 mm tube)	1
55.	Match Box	Ordinary	1
56.	Cotton	Ordinary	25 gms.
57.	Duster	Ordinary (Standard size)	1
58	Litmus Paper (Blue and Red)	Ordinary type (Two each)	4 pckts.
59	Filter Paper	-do-	2 sheets
60	Candles	-do-	2 pieces
61	Wooden Splinters (10 cm ×5 cm)	-do-	24 pieces
62.	Metallic strips	Copper —2pcs Iron —7pcs. Aluminium—2pcs. Zinc —2pcs Lead —1pc. } 15 mm.× 70 mm. size	13 Pcs.
63.	Washing Bottle 250 ml	Polythene	1

LIST OF CHEMICALS AND BOTTLES

Sr. No.	*Chemicals*	*Quantity*	*Type of container*
1.	Nitric Acid (Conc. Dil)		A + A
2	Sulphuric Acid -do-		A + A
3	Hydrochloric Acid -do-		A + A
4.	Phosphoric Acid (Dil)		A
5	Crude Oil		A
			8

6	Lime Water		B
7	Barium Chloride		B
8.	Sodium Hydroxide		B
9.	Petrol		B
10.	Calcium Hydroxide		B
11.	Kerosene Oil		B
			6
12.	Sodium Chloride	160 gms	C
13.	Potassium Permanganate	100 gms.	C
14.	Marble Chips	350 gms.	C
15.	Copper Sulphate	150 gms	C
16.	Zinc Pieces	300 gms	C
17.	Sodium Metal		C
			6
18.	Sugar	80 gms.	D
19.	Sulphur	20 gms.	D
20.	Charcoal	15 gms.	D
21.	Calcium Oxide	10 gms.	D
22.	Potassium Chloride	7 gms.	D
23.	Ammonium Nitrate	10 gms.	D
24.	Potassium Sulphate		D
25.	Copper Carbonate (Basic)	25 gms	D
26.	Ammonium Sulphate		D
27.	Calcium Phosphate		D
28	Calcium Super Phosphate		D
29.	Calcium Nitrate		D
30	Potassium Chloride		D
31.	Urea		D
32.	Potassium Nitrate		D
			15
33.	Nepthalene Balls	10 gms.	E
34.	Sodium Metal		E
35.	Starch	25 gms	E
36.	Calcium Hydroxide	30 gms.	E
37.	Phosphorus (Red)	13 gms.	E
38.	Magnesium Ribbon	15 gms	E
39	Copper Oxide	120 gms	E
40.	Sodium Acetate	10 gms.	E
41	Boric Acid	7 gms	E
42.	Potassium Sulphate	7 gms	E
43	Mercuric Oxide (Yellow)	50 gms.	E
44	Copper Turnings	25 gms	E
45.	Formic Acid	10 gms	E
			13
46.	Litmus Solution		F
47.	Phenolphthalein		F
48.	Methyl Orange		F
			3

49.	Vegetable Oil			G
50	Bromine Drops			G
51.	Vinegar			G
52.	Spirit			G
				4
53	Zinc Dust		6 gms.	H
54	Iron Powder		25 gms.	H
55	Magnesium Powder		25 gms.	H
56	Barium Chloride		5 gms.	H
57.	Silver Nitrate		1 gm.	H
58	Phenolphthalein		1 gm.	H
59,	Metoyl Orange		1 gm	H
				7
60.	Iron Wire	1 mm. dia 70 mm. long—10 Pcs		K
61.	Aluminium Wire			K
62.	Copper Wire			K
63.	Iodine Crystals		20 gms.	K
64.	Potassium Chloride		10 gms.	K
				5
65	Silver Nitrate		1 gm	X
66	Scent			Y
67	Sodium Hydroxide			Z

DESCRIPTION OF BOTTLES

A. Bottle (Acid and base proof) 48 mm. dia , 101 mm. long with a screw cap

B. Bottle (Acid and base proof) 43 mm., dia , 104 mm. long with a screw cap.

C Cylindrical container polythene 63 mm. dia., 80 mm length with inside lid and screw cap

D Wide mouth polythene bottle, 48 mm. dia., 95 mm long wide screw cap.

E. Cylindrical container polythene 37 mm. dia. 80 mm. long with a screw cap.

F. Polythene bottle, with inside nozzle, and a screw cap 40 mm dia.. 75 mm. long

G Polythane bottle, 40 mm dia., 81 mm. long with inside lid and screw cap,

H. Polythene tube, 20 mm. dia., 54 mm. long with screw cap

X, Coloured bottle, 25 ml.. with dropper.

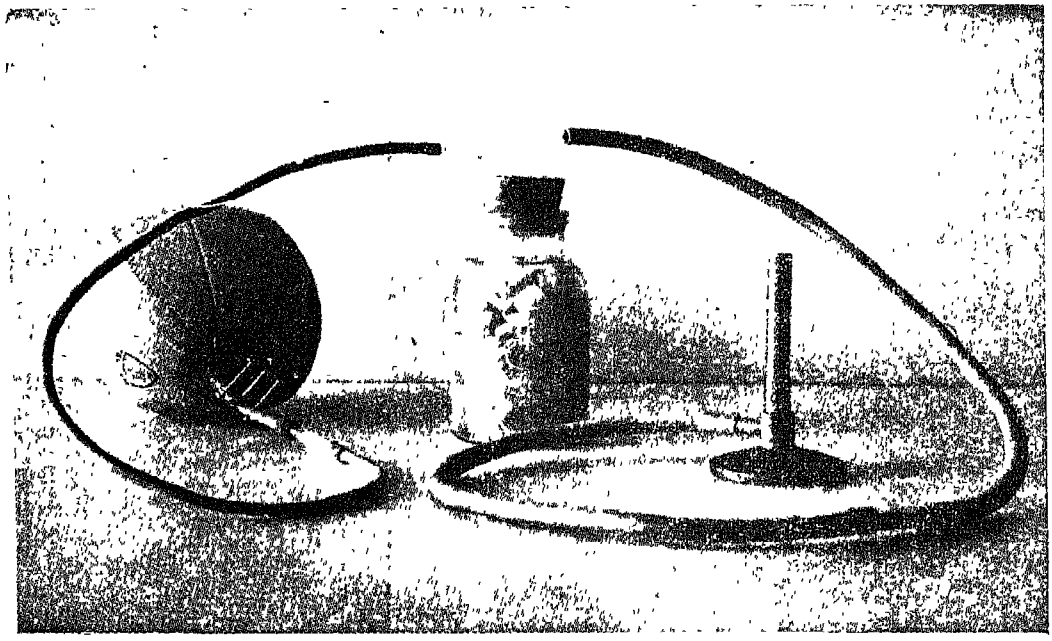
Y. 5 ml. bottle filled with scent.

Z 125 ml. glass bottle wide mouth.

K. Cylindrical container plastic 20 mm. dia.×80 mm. dia. with screw cap.

Examples of Improvisation

27. Petrol Gas Generator (*S N 2*)



Requirements

Although a kerosene lamp had been provided for normal use for heating, it was required to include a burner for heating to higher temperatures. It meant improvisation of a gas plant which is normally available in high schools and colleges. It should be inexpensive, safe and simple so that it is within the reach of a middle school where it could be utilized both by the teacher and the pupils.

The Prototype

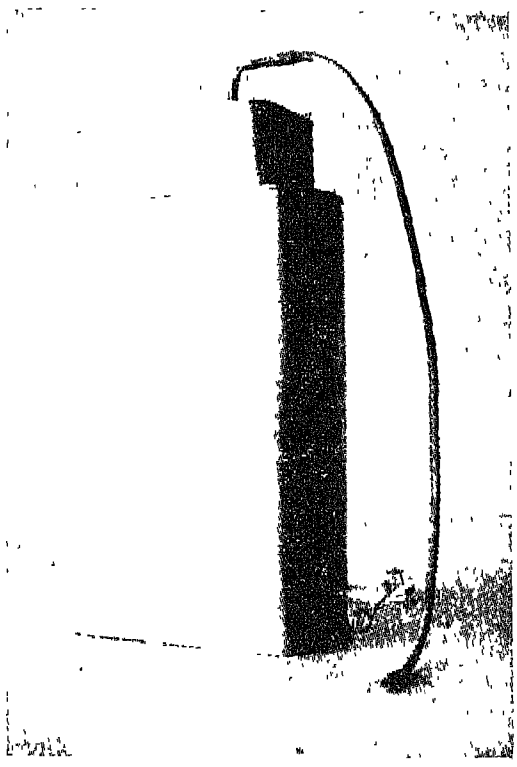
The device is quite simple. A football bladder or an old car tube is filled with air by the pump to supply air which goes to the petrol container. Wooden shavings are put in petrol to increase the surface area. Vapour of liquid petrol make the combustible gas which is directly fed to the Bunsen burner. Stop Cocks have been provided to regulate the supply of gas. A safety valve has been introduced by putting a glass tube containing copper spiral in between the two pieces of rubber tubing connecting the burner to the bottle containing petrol and wooden shavings. This will avoid any back-flash.

This is an ideal device for generating petrol gas in a village school. It is quite inexpensive All the parts can be replaced easily and supply of petrol is no problem.

Precaution

A long rubber tube should be used to keep safe distance of the petrol bottle from the burner A thick copper spiral in glass tube must be inserted in this rubber tube as it will check any flames from going to the petrol container from the burner.

28. GASOMETER (GAS HOLDER) (*S. No 16*)



Requirements

A gas holder for the storage of gases insoluble in water was required. It should be sturdy, inexpensive and simple. It called for replacement of conventional glass holder which might break by mishandling.

The Prototype

The prototype made of two used tin containers of 5 litre and 3 litre capacity with other fittings fulfils all requirements. It is sturdy and there is no question of its breaking even by mishandling. The outer container is filled with water and the smaller container without a bottom slides inside till all the air is expelled. The pinch cock at the top is then closed. The delivery tube is led to the bottom of the inside container which stores the gas. It is lifted up automatically when pressures of the gas builds up further. There is an outlet at the top of the gas holder which is connected to the delivery tube for supplying gas to perform experiments. Supply is regulated by a pinch cock.

29. IMPROVISED KIPP' APPARATUS (*S. No. 17*)

Requirements

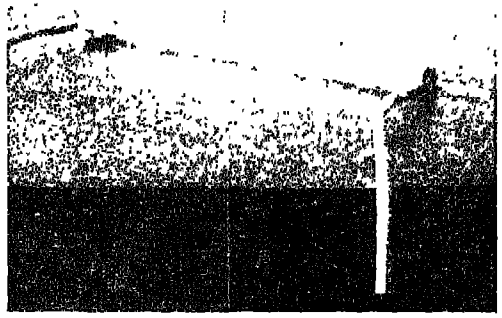
(i) A device to replace the conventional Kipp's apparatus for continuous intermittent supply of hydrogen and carbon dioxide gases.

The Prototype

The device was improvised by providing a fine hole in ordinary glass test tube which is suspended inside a reagent bottle through a rubber stopper. This hole can be made by closing the mouth of test tube with a rubber cock and heating the bottom on a flame till it becomes soft. Expansion of air forces a hole through the soft bottom. The bottle a partly filled with dilute hydrochloric acid. Marble chips or zinc pieces are put inside the test tube according to requirement of carbon dioxide or hydrogen gas. The test tube is fitted with a rubber cork through which passes the delivery tube. A pinch cock may be provided on the rubber tube connecting the delivery tube to regulate the supply of gas

Note. A second variant was also designed and is mentioned at P. 43 of the Kit Guide.

30 LIEBEG'S CONDENSER—IMPROVISED DISTILLATION APPARATUS (*S No. 18*)



Requirements

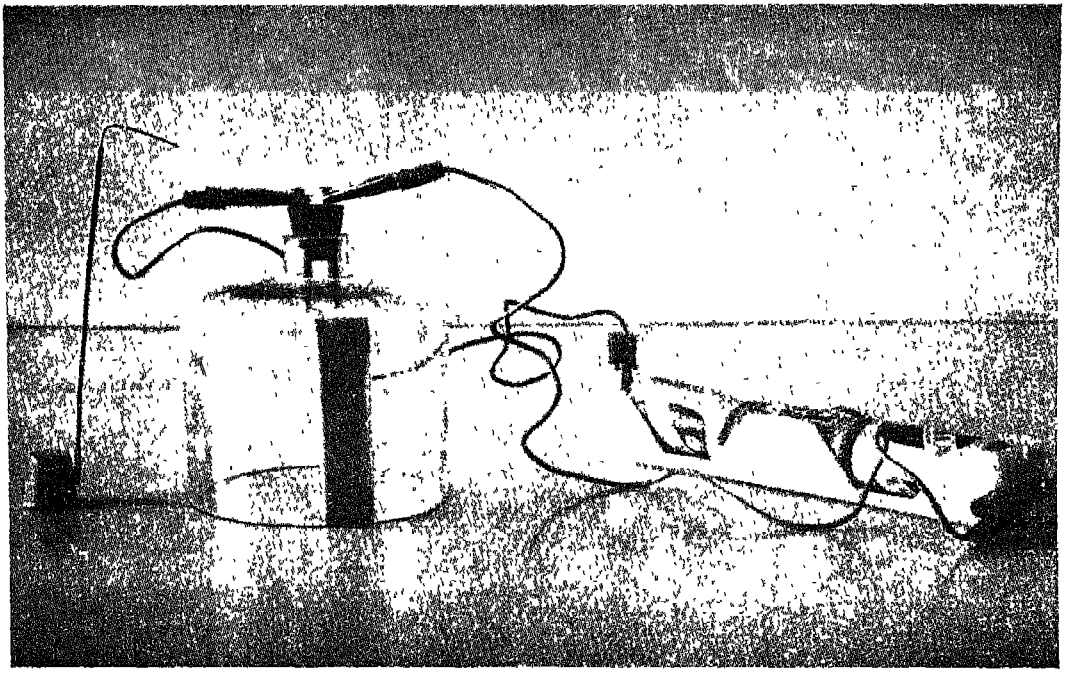
(i) An improvisation of the conventional Liebeg's Condenser for fractional distillation of crude oil and distillation of water.

(ii) Should be simple and inexpensive.

The Prototype

The improvised apparatus is rather simple and eliminates the water pumps or municipal tap water for circulating the cold water which is fed by gravitational force and is collected at the bottom in a bucket. This can again be put in the supply task manually as and when required. The distilled liquid is conveniently obtained in a beaker. The operation is simple and the parts are easily replaceable.

31. VOLTAMETER/BELL JAR (*S No. 19*)



Requirement

(i) A device for the analysis of water and for determining composition of air.

(ii) It should be simple and inexpensive.

The Prototype

A bottomless narrow mouthed glass bottle serves as a voltameter for analysis of water if inverted and also as a bell jar for determining quantity of oxygen present in air.

As a voltameter, a rubber stopper is provided at its mouth which carries two iron nails each connected to the terminals of 3/4 dry cells. The glass bottle is inverted and 10% solution of sodium hydroxide is put which serves as the electrolyte. This is important to make the iron nails serve as electrodes. Oxygen and hydrogen gases are collected in proportion in the test tubes containing water and inverted over the electrodes

LIST OF DEMONSTRATION EXPERIMENTS

PART I

Sr No.	*Experiment*	*Apparatus*	*Chemicals*	*Items to be arranged locally*
1.1	Classification of objects	Test tube (1) watch glass (1) glass bottle (1)	—	Book (1) sheet of paper (1) Notebook (1)

1 2	Handling of a kerosene lamp	Kerosene lamp (1)	—	Kerosene (100 ml.) Match box (1)
1.3	Heating of a liquid in a boiling test tube	Boiling test tube (1) Test tube holder (1) Kerosene lamp (1)/ Burner	—	Water
1 4	Use of wooden or Metallic laboratory stand	Laboratory stand (1) (wooden or metallic)	—	—
1 5	Heating of a solid substance in a test tube (sugar)	Boiling test tube (1) Laboratory stand (1) Kerosene lamp (1) Burner	—	Sugar (10 g)
1 6	Cleaning of a test tube	Test tube (1), Test tube brush (1)	—	Water, Piece of paper
1 7.	Classifying objects in the following groups : (a) Liquids (b) white crystaline substances (c) objects made of glass (d) Metals of glass	Glass tube (1) Glass rod (1)	Sugar (10 g.) Common salt (10 g) Vinegar (10 ml) Napthalene (10g) Copper (1) Aluminium (1) Iron (1) Zinc (1) Lead (1)	Petrol (10 ml) Kerosene (10 ml.)
1 8.	Determining the boiling point of a liquid	Thermometer (—10 110°C) Laboratory stand (1) Boiling test tube (1) Kerosene lamp (1) burner	—	Water
1.9	Comparing the melting point of wax and sulphur	Test tubes (2), Beaker (1) (250 ml.) Gas burner (improvised), wire gauze	—	(Sulphur (5 g.), Wax 5 g)
1.10.	Determining the melting of ice	Funnel (1) Thermometer (—10°C 110°C), Beaker (1) Chloride 250 ml , Laboratory stand	Sodium Chloride	Ice
1 11	Pouring of carbon-dioxide gas	Gas jar (1), Beaker 250 ml (1), Kipp's apparatus (improvised)) for the preparation of Co_2	Marble chips, HCl or H_2SO_4 (dil.)	Candle
1 12.	The molecular movement	Glass plate (1)	—	—

1.13.	Diffusion of Gases (a) Bromine with air and carbon dioxide (b) Ammonium hydroxide with hydrochloric acid gas (optional)	Gas jar (2) gas jar disc (1) Watch glass (2) Glass Tubing with a jet (1) Kipp's app (Improvised) for the preparation of Co_2. (b) Round bottom flask (1) bent tubing 90° (2), Funnel (1), Glass tubing (1), Laboratory stand (1) Gas jar (1), Gas jar disc (1), Kerosene lamp, (1), Watch glass (1), Rubber stopper with two holes (1), Rubber tubing for joints	Bromine drops marble chips, dil hydrochloric acid (b) Ammonium Hydroxide, Sodium Chloride, Concentrated Sulphuric acid	Bottle of scent
1.14	Diffusion of Liquids (Potassium Permanganate and water)	Boiling test tube (1), separating funnel (improvised) Rubber stopper with hole for delivery tube, laboratory stand	Potassium Permanganate	Water
1.15	Inter Molecular Distance	Syringe (1)/foot ball pump (1)	—	—
1.16	Expansion of liquids on heating and contraction on cooling water	Kerosene lamp (1), boiling tube (1), laboratory stand (1), glass tubing 30 cm long, Rubber stopper with a hole	$KMNO_4$	Water
1.17.	Evaporating the solution	China dish (1), Tripod stand (1), Wire gauze (1), Kerosene lamp (1)/Petrol gas generator (Improvised) (1)	—	Sodium Hydroxide and Water
1.18	Effect of impurity on the boiling point of the liquid (common—salt in water)	Beaker (1), Glass rod (1), Thermometer (1), Petrol gas generator (improvised) (1), Laboratory stand (1) Wire gauze (1)	Sodium Chloride	Distilled water
1.19	Purification by decantation (Impure water)	Beaker (2), 100 ml. and 250 ml Glass rod (1)	Sodium Chloride	Distilled water
1.20.	Separation of two Immiscible liquids (oil and water)	Separating Funnel (Improvised) (1), Laboratory stand (1), Boiling test tube (1), Beaker 250 ml. (1), Laboratory stand	—	Vegetable oil and Water
1.21	(a) Preparation of a filter (b) Filteration of an impure liquid (impure water)	Funnel (1), Beaker (1) Glass rod with a rubber tubing at one end, laboratory stand (1), Filter paper Scissors, funnel	—	—

1 22.	Evaporation of water on heating and condensation on cooling	Improvised petrol gas generator (1), Laboratory stand (1), Funnel (1), Beaker 250 ml (1)	—	Water
1.23	Heating of a copper plate	Laboratory stand (1), Petrol gas generator (Improvised), Knife (1)	Copper plate	—
1 24	Studying the changes on heating of starch	Laboratory stand (1) Filter paper (2), Boiling test tube (1), Jet tube (1) Rubber stopper with a hole (1)	Starch	Match-box
1.25.	Freezing water in a test tube	Beaker 250 ml (1), Test tube (1), Test tube stand (1)	Sodium Chloride	Ice, Water
1 26	Indications of a chemical reaction (silver nitrate and sodium chloride or barium chloride with sulphuric acid)	Test tube (3), Test tube stand (1)	Silver Nitrate, Sodium Chloride or Barium chloride, Sulphuric acid	Common salt
1.27	Interaction of dilute Hydrochloric acid with marble chips and testing the gas evolved.	Boiling test tube (1), Bent tubing 90° (1) Bent tubing 45° with a jet (1), Glass tube (1), Rubber stopper with a hole (1), Laboratory stand (1) Rubber tubings (2)	Hydrochloric Acid, Marble chips, Calcium Hydroxide	—
2 1	Decomposition of basic copper carbonate	Boiling tube (1), Test tube (1), Bent tube 90°, Laboratory stand (1), Kerosene lamp (1)	Basic Copper Carbonate, Lime water	Water
2.2	Decomposition of Mercuric Oxide	Boiling test tube (1) Delivery tube (1), Gas jar (1), Laboratory stand (1), Kerosene lamp trough (1), Rubber tubings (2), Rubber stopper with two holes	Mercuric oxide	Water
2.3.	Decomposition of water	Hard glass test tube (2), Holder with 3 dry cells (1) Laboratory stand (1) Voltameter (Improvised cup), two sets of wire with crocodile plugs	Dilute Hydrochloric acid	Water
2 4.	Reaction of combination (Iron and Sulphur) (a) Mixing together (b) Formation of Iron Sulphide	Beakers (3), Magnet (1), Mortar and Pestle (1), Glass tube (1), Stand (1), Burner (1), Forceps (1), Trough (1)	Iron powder, Sulphur, Iron powder, sulphur	Water

2 5.	Reaction of combination (Zinc dust and sulphur)	as in 2·4	Sulphur, Zinc dust	—
2 6	Law of conservation of Mass (a) Burning of Phosphorous (b) Barium Chloride and dilute Sulphuric acid	(a) Round bottom flask (1), Stopper (1), Kerosene lamp (1), Test tube holder (1), Balance and weight box, (b) Boiling test tube (1), Ignition tube (1), Rubber stopper (1), Balance with weight box	Phosphorous, Barium chloride, Dilute sulphuric acid	a string
3 1	Composition of air	Voltameter cup (Bell jar) (1), Deflagrating spoon (1), Trough (1), Rubber stopper with a hole for deflagrating spoon (1), Burner	Red Phosphorous	Water
3.2	Preparation of oxygen (Decomposition of Potassium Permanganate	Boiling tube (1), Laboratory stand (1), Trough (1), Gas jar (2), Bent tubing 120°, 45° (1), Glass tubing (1), Rubber stopper with a hole (1), Improvised petrol gas generator or Kerosene lamp (1)	Potassium Permanganate, Cotton	Water,
3.3.	Reaction of oxidation (Burning of carbon, sulphur, phosphorous, magnesium and iron with oxygen and testing the oxide formed)	Gas jars (2), Deflagrating spoon (1), Trough (1), Kerosene lamp or burner (1), A piece of cork	Potassium Permanganate, Charcoal, Lime water, Sulphur, Red Phosphorous, Magnesium Ribbon Steel Wire (from some string instrument)	—
3.4	Preparation of oxygen (Decomposition of potassium chlorate) (Optional)	Boiling tube (1), Test tube holder (1), Kerosene lamp (1), Bent tubing 120° and 45° (2), Jars (2) Rubber joints (2)	Potassium Chlorate	Water
3.5.	Preparation of carbon dioxide by decomposing basic copper carbonate and studying the physical properties of gas evolved	Boiling tube (1), Test tube (1), Bent tube 20° (1), Laboratory stand (1), Kerosene lamp (1)	Basic Copper Carbonate powder, Calcium Hydroxide	Water
4.1.	Preparation of Hydrogen (*a*) In a boiling tube (*b*) In Improvised apparatus	Boiling tube (1), Laboratory stand, Improvised Kipp's apparatus (1)	Zinc pieces, Dilute Hydrochloric acid	—

4 2	Physical properties of hydrogen (testing its lightness) (*a*) Inverting of a cylinder (*b*) Soap bubbles experiment.	Improvised hydrogen gas generator, gas jars (2), Glass disc (2), China dish (1)	Zinc pieces, dilute Hydrochloric acid, Soap solution, A few drops of glycerine	–
4 3	Burning of hydrogen in oxygen	Improvised hydrogen gas generator (1), Gas jar (2), Apparatus for preparation of O_2	Zinc pieces, dilute Hydrochloric acid, Potassium Permanganate	Water, Match box
4 4	of Hydrogen in air	Improvised hydrogen gas generator (1)	Zinc pieces, dilute hydrochloric acid	Water, Match box
4 5.	Purity of hydrogen gas	Improvised hydrogen gas generator (1) Test tube (2)	Zinc pieces, dilute Hydrochloric acid	Water, Match box
4 6	Reduction of Cupric oxide by hydrogen	Test tube (Hard glass) (1) Improvised hydrogen gas generator, Kerosene (1), Bent lamp tubing with a jet at the long end	Zinc pieces dilute Hydrochloric acid, Copper Oxide	-
4 7.	Physical properties of acids (*a*) Hydrochloric acid (*b*) Sulphuric acid	(*a*) Test tube (4), Bent tubing 90° (1), glass rod (1), rubber stopper with a hole (1) (*b*) Test tubes (2), glass rod (1) beaker (1)	Marble chips, Hydrochloric acid, Litmus Paper, Lime water, Sulphuric acid, marble's piece	Water/Splinter
4 8	Action of acids on litmus solution	Test tubes (3), test tube stand (1), Dropper (1)	Hydrochloric acid, sulphuric acid, litmus solution	Water
4 9	Action of sulphuric acid on wooden splinters	Test tube (1), Test tube stand (1)	Litmus solution, Sulphuric acid	Wooden splinter
5 1.	Heating of dry splinters, soil or blotting paper in a test tube (showing the presence of water in these)	Test tubes (3) Laboratory stand (1), Kerosene lamp (1)		Wooden splinter soil, blotting paper
5.2.	Distillation of water	R.B flask, laboratory stand, petrol gas generator of Kerosene lamp (1), Liebeg's condenser (Improvised) rubber stopper with a hole (1), bent tubing 90° (1), Rubber tubing		Blotting paper, Coloured saline water
5.3.	Reaction between sodium and water	Pair of tongs (1) Filter paper (1), Boiling test tube (1), Watch glass (1), Laboratory stand (1), Rubber stopper with hole (1), glass tubing with a jet (1)	A piece of sodium metal	Splinter

5.4.	Interaction between magnesium and steam	Boiling tube (1), Rubber stopper with a hole (1) bent tubing 90° (2) and 45° (1) Reaction tube (1) Burner (1), laboratory stand (2), Trough (1), Test tube (1), Rubber tubing (3), Kerosene lamp (1), Tripod (1)	Zinc powder	Water
5 5	Studying the solubility of common salt	Glass rod (1), Beaker (1), Balance and weight box, wire gauze (1)		Common salt water
5 6	Growing of a large crystal	Beaker (2), Stirrer (1), Kerosene lamp (1), Laboratory stand (1) Funnel	Copper Sulphate	Thread, Water, Cotton
5 7	Effect of temperature on solubility of Potassium Nitrate	Test tube (1), Beaker (1), Laboratory stand, Kerosene lamp	Potassium Nitrate	Water
5.8.	Solubility of gases in water	Test tube (1), Beaker (1), Kerosene lamp (1), Laboratory stand (1)	—	Water
5 9	Dissolution of Sodium Hydroxide in water	Watch glass (1), Test tube (1), Glass rod (1), Test tube stand (1)	Sodium Hydroxide	Fresh cold water
5 10	Studying the action of an indicator on Sodium Hydroxide	Test tubes (2) Test tube stand (1) Dropper (1)	Litmus solution, Phenolpthalein	Water
5.11	Reaction of neutralization (*a*) simple method (*b*) by titration method	Test tubes (3), Polythene dropper (1), Beaker (1), Burette (1), Pipette (1) Glass rod (1) Laboratory stand (1) Test tub stand (1)	Sodium Hydroxide, Hydrochloric acid, Phenolpthalein	Water
		PART II		
1 1	Interaction of basic oxides with acids	Test tube (1), Watch glass (1), porcelain dish (1)	Sodium Oxide, Calcium oxide, Magnesium Oxide, Phenolphthalein	—
1.2	Interaction between carbon dioxide and lime water	Funnel (1), Test tubes (2), Pinch cock (1) Rubber tubing (1), Glass tubing (1), Bent tube 90° (2) Laboratory stand (1)	Dilute Hydrochloric acid, Calcium Hydroxide, Marble chips	—
1.3	Reaction of combination of basic and acidic oxides	A loop of wire (1), China dish (1), Improvised petrol gas generator (1)	Dilute Hydrochloride acid, CuO, SiO_2 (sand) B_2C_1CaO	Match box

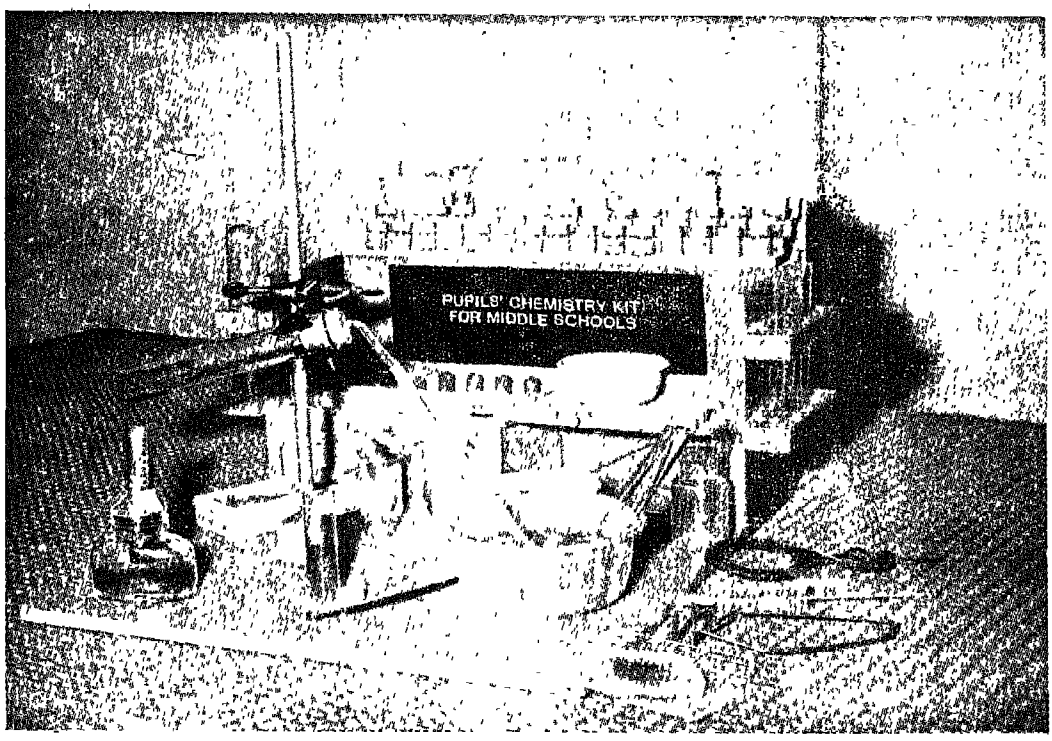
1.4.	Interaction of acidic oxides with bases	Round bottom flask (1), Funnel (1), Rubber tubing (1), Bent tube 90° (1), Pinch cock (1), Rubber stoppers (1), Kipp's Apparatus (Improvised) as a source for CO_2	Dilute Hydrochloric acid, Marble chips, Caustic soda	
1 5.	Interaction of acids with metals (Zinc and Sulphuric acid)	Test tube (2), Rubber Stopper (1), Jet tube (1), Watch glass (1), Wire gauze, Kerosene lamp (1), Laboratory stand (1)	Zinc pieces, Magnesium, Ribbon, Dilute Hydrochloric acid, Dilute Sulphuric acid	Match box
1 6.	Interaction of acids with metals (Copper and Nitric acid)	Test tube (1), Watch glass (1), Wire gauze (1), Kerosene lamp (1), Laboratory stand (1) Test tube stand (1)	Copper turnings, Concentrated Nitric acid	Match box, splinter
1.7.	Interaction of acids with bases (Hydrochloric acid and Copper-Hydroxide	Test tube (1), Test tube stand (1), Watch glass (1), Wire gauze (1), Kerosene lamp (1), Laboratory stand (1)	Dilute Hydrochloric acid, Copper Hydroxide (freshly prepared)	
1.8	Interaction of acids with salts (Sulphuric acid and Sodium Chloride)	Test tube (1), Test tube stand (1), glass rod (1), test tube holder (1), Kerosene lamp (1), Test tube stand (1)	Sodium chloride, (solid), concentrated Sulphuric acid, Ammonium Hydroxide solution	
1.9.	Action of heat on Alkalis (Caustic Soda)	Spatula (1), Test tubes (2), Test tube holder (1), Kerosene lamp (1), Test tube stand (1)	Caustic Soda, Red Litmus solution	Water
1 10.	Action of heat on insoluble bases (copper hydroxide and ferric hydroxide)	Test tubes (2), Test tube holder (1), Kerosene lamp (1), Test tube stand (1)	Copper Hydroxide Ferric Hydroxide (freshly prepared)	—
1.11.	Interaction of salts with acids (Potassium Nitrate with Sulphuric acid)	Test tubes (2), Test tube stand (1), Kerosene lamp (1), Test tube holder (1)	Potassium Nitrate, Concentrated Sulphuric acid	—
2.1.	Identification of Fertilizer (Potassium Chloride)	Graphite stick, Watch glass (1), Burner, Test tube stand (1) test tube	Concentrated Hydrochloric acid, Potassium chloride, Silver Nitrate Ammonium Hydroxide	Match box, water
2.2.	Identification of the Fertilizer (Ammonium Nitrate)	Test tube (1), Test tube holder (1), Burner (1), test tube stand (1), test tube, pair of tongs blow pipe	Ammonium Nitrate, Sodium hydroxide, Red litmus paper	Piece of charcoal

3.1.	Showing the presence of carbon in the following substances (*a*) wood chips (*b*) saw dust (*c*) sugar (*d*) cotton (*e*) wool	Test tube (6), Bent tube 90° (1), Rubber stopper with a hole (1), Laboratory stand (1), Burner, Rubber joints (2)	Calcium Hydroxide, lime water	Wood chips, Saw dust, Sugar, Cotton, Wool
3 2	Destructive distillation of wool	Boiling tubes (1), Rubber stopper with a hole (1), Bent tube with jet, Burner, China dish (1), Laboratory stand (1)	Blue litmus paper	Dry splinters, Match box
3.3	Absorbing property of charcoal	Round bottom flask (1), Rubber stopper (1), Laboratory stand (1), Kerosene lamp (1), Wire gauze (1)	Bromine drops	Charcoal pieces
3.4	Reduction of Copper Oxide by Carbon (charcoal)	Boiling test tube (1), Beaker (1), Laboratory stand (1), One holed rubber stopper (1) Kerosene lamp (1), Bent delivery glass tubing, Rubber tube	Copper Oxide, Lime water	Charcoal powder
3 5.	Preparation of carbon monoxide	Improvised Kipp's apparatus (1), Improvised gasometer (1)	Sodium Formate, Sulphuric acid (Conc)	—
3.6	Reducing property of carbon monoxide	Improvised gas generator (1) or gasometer reaction tube (1), Kerosene lamp (1), Laboratory stand (2), Burner, Rubber stoppers (2), Glass tubing (1)	Sodium Formate, concentrated sulphuric acid, Copper Oxide	Charcoal powder
3.7	Preparation of Methane and its burning	Improvised gasometer (1), Boiling tube (1), Laboratory stand (1), Improvised gas burner (1), Rubber stopper with a hole (1), Bent tubing (90°, 45°), (1), Rubber tubing, glass tubing (1)	Sodium Acetate, Sodium Hydroxide, Calcium oxide	Match box
3.8.	Distillation of crude oil	Round bottom flask (1), Test tubes (4), Laboratory stand (2), Thermometer (0-200 c), Rubber stopper with a hole (1), Liebeg's condenser (Improvised) (1), China dish (1), bent tubing 90° (1), 100° (1)	Crude oil	

3.9	Study of the structure of flame	Improvised petrol gas generator (1), Narrow glass tube (1), Porcelain piece, blow pipe (1)	—	Candle stick, Match box
3.10.	(*a*) Identification of starch (*b*) showing its presence in other compounds	Test tube (3), Test tube holder (1), Beaker (1), Tripod stand (1), Glass rod (1), Kerosene lamp (1), Test tube stand (1), Wire gauze (1)	Starch powder, Iodine solution	Wheat, Bread, Potatoes
3.11	Properties of Proteins (egg)	Test tubes (3), Test tube holder (1), Test tube stand, Kerosene lamp (1)	Nitric acid concen	Cotton fibre, Woollen fibre, egg
4.1.	Hardness of a metal (Sodium Metal)	Pair of tongs (1), Watch glass (1), Filter paper	Sodium Metal	Knife
4.2	Malleability of metals (Steel, zinc and lead)	—	Piece of steel, Piece of zinc, Piece of lead	Hammer, Block of Iron
4.3	Interaction of zinc and water	Test tubes (2), Lab. stand (1), Rubber stopper with a hole (1), Bent tube 90° (2), 45° (1), Reaction tube Improvised (1), Burner, Kerosene lamp (1), Trough $\frac{1}{4}$ (1), Tripod stand	Zinc powder	Water, Wooden blocks (2)

CHEMISTRY PUPIL'S KIT FOR MIDDLE STAGE

D S E. (C.S.W.) VIII



To provide adequate opportunity to the students to perform experiments in chemistry a special kit has been developed. Two students can work at a time. A tiny box 37 cm. x 14·5 cm. x 21 cm. height contains 37 different items, (several numbering more than one), 40 chemicals and 10 containers for solutions and acids. To complete the kit it has been suggested to arrange locally 31 miscellaneous items. Entire space available has been utilised to the maximum extent. A stepped container has been provided to keep 60 phials. This container can be fixed on the top of the box so that it does not make any hindrance to working. Just below these, two wooden boxes are placed. These can also be taken out while performing the experiment.

This kit has also been designed keeping in view a village school which may not have any demonstration table. Thus the top front covers, hinged at the junctions at the top and bottom of the box, can be spread out on the ground or on improvised table to provide working space for the students. These two sides could be coated with epoxy paint which is acid proof in case cost is not the main consideration. On both sides of the box two test tube stands are provided for holding two boiling and eight test tubes. These stands also serve as handles for lifting the kit and carrying to places. Similarly a

burette has been fixed in the hollow space at the back of the stepped container to utilise all available space.

It is suggested that five such kits are provided by every school so that a batch of 10 students can perform experiments at a time. Thus a class of 30 students can be split into three groups of 10 students each. All pupil's activities as listed in the textbooks can be covered. Chemicals and other consumable items will last for one year after which these have to be replenished. This is a very inexpensive kit so that it remains within the reach of every school.

LIST OF ITEMS

Sr. No.	*Name of the item*	*Qty*
1.	(a) Iron rod	One
	(b) Base wooden block with a fixed nut in it	One
2.	Test tube stand for holding two boiling and eight test tubes (part of box)—serving as handles of the kit	Two
	ITEMS PLACED IN BOX 'A'	
	(a) The lower part of the first compartment	
3.	Test Tube (neutral glass, 10 cm x 1·7 cm) good quality	Seven
4.	Test Tube (neutral glass, 10 cm. x 1·7 cm) good quality (with a hole at the bottom)	One
	(b) Upper portion of the first compartment (B box)	
5.	(a) Set of delivery tubes (corning quality, 6 mm. outer dia. 1·2 mm wall thickness)	
	(i) bent at 45° (3 cm. x 4 cm)	Two
	(ii) bent at 90° (3 cm. x 4 cm)	Three
	(iii) bent at 120° (3 cm x 4 cm.)	Two
	(iv) bent U type (each arm 2 5 cm. long)	Two
	(v) tube with a jet (5 cm. long)	Two
5.	(b) Glass tube with a jet (5 cm. long, outer dia, 8 mm)	One
6.	Rubber Stoppers	
	(i) No. 2	One
	(ii) No. 2 with a hole (6 mm.)	One
	(iii) No. 5 with a hole (17 mm.) (to allow test tube of item 4 to be fitted) To fit item 27	One
	(iv) No. 6 with two holes (6 mm.)	One
	(v) No 6 with one hole (6 mm.)	One
7.	Rubber Tubing, Rubber Ring	
	(i) 7 cm. long (dia. 10 mm. outer)	One
	(ii) 2 5 cm long (dia. 8 mm. outer)	Six pieces
	(iii) Rubber disc 2 cm. dia. with a hole near the circumference	One
8.	Pinch Cock (screw type)	One
9.	Dropper (polythene) (good quality)	Two
	First compartment of the box	
10.	Beaker (neutral glass 50 ml.)	One
11.	Beaker (neutral glass 25 ml.)	One
12.	Polythene bottle (for indicator) (As per sample approx dia. 20 mm length 45 mm. 5 ml. capacity)	One
13.	Watch glass (5 cm. dia) (neutral glass)	One

Second compartment of the box

14	Test tube (Corning, 15 cm. x 2 cm)	One
15	Boiling tube (Corning, 15 cm x 2·5 cm.)	Two
16	Glass rod (with police-man) 5 mm (14 cm long) (placed in the long test tube)	To be placed inside One
17.	Glass tubing (Corning) (14 cm long x 6 mm. outer dia.) same as 5 (a)	No. 14 Three
18	Litmus paper (red and blue)	Two packets of each

Third Compartment of the box

19	Dropping bottles for chemicals (Amber colour about 15 ml. capacity fitted with rubber droppers)	Seven
20.	Filter paper (placed below the box)	Half standard Sheet

Lower portion, on right hand of the kit, next to the box

21.	Trough polythene (13 cm dia.) 65 mm.	One
22.	Trough polythene (8 5 cm dia.) 35 mm.	One
23.	Kerosene lamp with perforated chimney with wire tong	One
24.	Evaporating enamel dish (7 5 cm. dia. flat type) (To fit inside No 22)	One
25	Funnel (5 cm dia. polythene)	One
26.	Wash bottle 80 ml (40 mm dia) 75 mm long with nozzle inside and screw cap made of polythene)	One
27.	Wide mouth bottle 50 ml (39 mm. dia 72 mm height, width of the mouth 30 mm. outer, made of glass) (To fit item 6 (iii))	One
28	Rubber tubing 15 cm. long (8 mm dia. outer)	One

ITEMS PLACED IN BOX 'C'

29.	Test tube holder	One
30.	Spatula (workshop design) plastic	One
31.	Clamp holder	One
32.	Ring clamp	One
33.	Clamp extension	One
34.	Deflagrating spoon (as per sample)	One
35	Test tube brush	One
36.	Wire gauze (10 x 10 cm) with asbestos	One
37.	Burette fixed under the gallery (25 ml.) (neutral glass)	One
38	Wooden Box (A)	One
39.	Plastic Box (B)	One
40	Wooden Box (C) open from top 315 x 50 x 30 mm. height (outside) wall thickness 3 mm.	One
41.	The kit box	

LIST OF CHEMICALS

I ROW

17 ml (glass)

1. $Ca(OH)_2$
2. CaO
3. $NaOH$
4. $NaNO_3$
5. NH_4NO_3
6. $Pb(NO_3)_2$
7. $FeSO_4$
8. $FeCl_3$
9. $Zn(NO_3)_2$
10. $Cu(NO_3)_2$
11. Iodine crystals
12. $K\,MnO_4$
13. KNO_3
14. $Ba(NO_3)_2$
15. $BaCL_2$

II ROW

13 ml. (polythene)

1. $CaCl_2$

2 $CuCO_3$(basic)
3. —do—
4 NaCl
5. —do—
6. $CaCO_3$ (marble chips)
7. —do—
8 Zn pieces
9. —do—
10. $CuSO_4$
11. —do—
12. Sugar
13. Sulphur
14 $CuCl_2$

III ROW

7. *ml*

1 Starch
2 —do—
3 CuO
4 —do—
5 MgO
6. Na_2CO_3
7. —do—
8 Fe_2O_3 or Fe_3O_4
9 Kcl
10. —do—
11. $CaCO_3$ (salt)
12 Na_2SO_4
13. —do—

IV ROW

7 *ml*

1. $NaHCO_3$
2. $AgNO_3$
3. K_2SO_4
4 PbO
5. P (red)
6. Cu (turning)
7. Fe (powder)
8 Mg (ribbon)
9 C (Charcoal powder)
10 Cu (wire)
11. Fe (wire)
12 Al (wire)
13. Glycerine
14. Litmus (powder)
15 Methyl orange.

Acids Bases placed in the Ist compartment of the Box.

1. HCl
2. H_2SO_4
3. HNO_3
4. H_3PO_4
5. CH_3COOH
6. NH_4OH
7. NaOH

To be provided in the kit

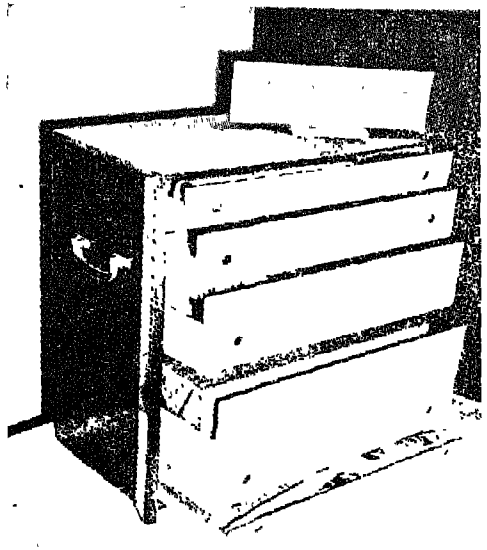
Copper plate
Iron plate
Aluminm plate
Lead plate
Zinc plate
Splinters of wood.

To be arranged locally

1. Graphite stick or Platinum wire
2. Plastic
3. Sand
4. Kerosene oil
5. Mustard oil
6. Vaseline
7. Scent
8. Vinegar
9. Spirit
10. Petrol
11. Naphthalene
12. Chalk powder
13. Iron nails
14. Groundnut seed
15. Boiled egg
16. Knife
17. Sand paper
18. Wool

PHYSICS DEMONSTRATION KIT III

C S W. IX



This kit completes the series of Physics Kits for middle school and is meant for the final year class. Apparatus has been improvised in subject areas of light, magnetism and electricity. This is contained in a wooden box measuring 530 mm. × 290 mm. × 620 mm. height. There are 74 items including the kit box. The top of this box may be utilised as the demonstration table in village schools where separate tables are not available. This box, when not in use, may be kept in the corner of a room and so it eliminates storage problems.

A special smoke chamber has been developed for experiments on light. The source of light will be the natural sunlight which is available in India round the year. Openings for admitting sun rays have been provided on both sides so that the box may be used in the same position either in morning or after noon hours. The device enables vision of rays in various phenomena so that students can actually see the diversion of rays through different media. It replaces the paper and pin exercise and leaves an ever lasting impression on the young mind.

Keeping in view a village school where electricity may not be available, the apparatus for magnetism and electricity is so designed that it operates on the combination of three dry cells which have been provided in a container in the Kit. The models are simple, effective and inexpensive. The size of each of the items is big enough to be observed by the entire class. A kit guide has been provided which explains the use of various items.

Reference Book Published (NCERT)

(a) Text Book—
Physics Part III—Science for Middle School (revised)

(b) Teacher's Guide for Physics Part III

(c) Kit Guide

Scientific Topics covered under the New Curriculum

1. Light
2. Electric charges and electric field
3. Electric current
4. Potential difference in resistance
5. Electromagnetism
6. Electric energy and Power
7. Structure of atom and atomic energy

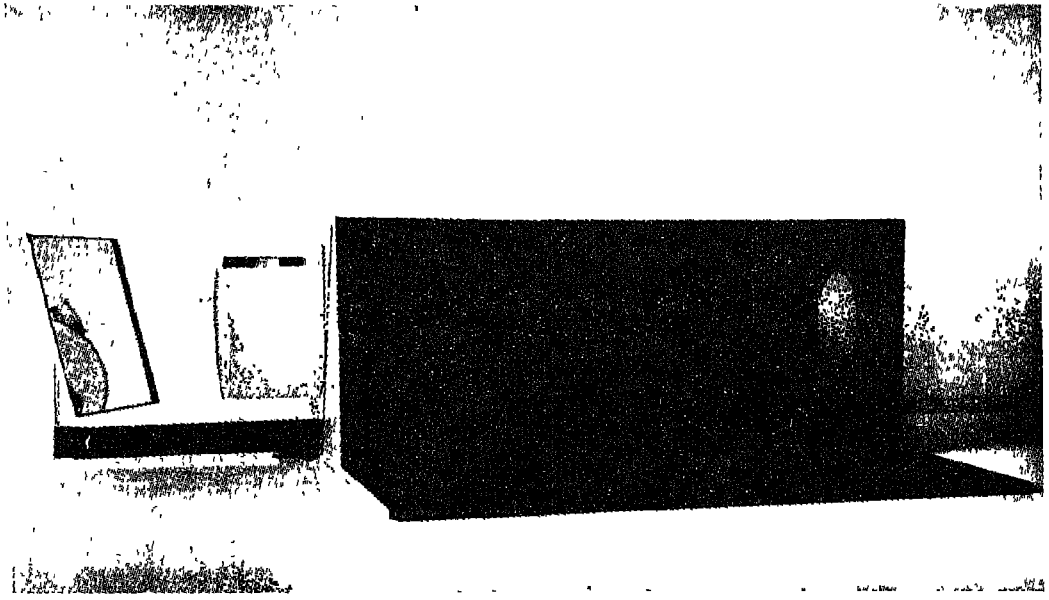
LIST OF ITEMS

S. No.	*Chapter*	*Item*
P D. 301.	General	Laboratory stand with clamp and boss-head
302.	-do-	Paper clips (1 doz.)
303	-do-	Screw Driver (100 mm) (good quality)
304	-do-	Cello tape (12 mm.)
305	-do-	Dry cells (3)
306.	-do-	Container box for 3 Dry cells (polythene)
307	-do-	Electric-connector (with plastic board and crocodile clips)
308	-do-	Set of connecting wires (6 pairs) 4-50 cm and 8-35 cm.
309	-do-	Bar Magnets (pair) (good quality)
310.	Chapter I	Smoke box
311	-do-	Disc holder
312.	-do-	Adjustable plane mirror on stand
313	-do-	Holder with two convex lenses (for producing point source)
314	-do-	Cover with slits
315	-do-	Cover with 'F' slit
316.	-do-	Cover without slit
317·	-do-	Metallic container for smoke source
318.	-do-	Periscope
319.	-do-	Plane mirror (small)
320.	-do-	Glass slab rectangle shape
321.	-do-	Glass slab 'D' shape
322.	-do-	Prism
323	-do-	Convex lens
324.	-do-	Concave lens
325.	-do-	Concave and convex mirrors
326.	-do-	Screen with hook
327.	-do-	Pinhole camera
328.	-do-	Stand for lens
329.	-do-	Screen
330.	-do-	Photometer
331.	-do-	Screen with rectangle cut
332.	-do-	Plastic ball (small)
333.	-do-	Plastic ball (big)
334.	Chapter II	Electrophorous (20 cm dia)
335.	-do-	Plastic strip with positive charge
336.	-do-	Plastic strip with negative charge
337.	-do-	Piece of Silk (pure) (20 cm. × 20 cm.)
338.	-do-	Piece of woollen cloth (20 cm ×20 cm.)
339.	-do-	Plastic strip with a piece of woollen cloth
340.	-do-	Electroscopes (pair)

341.	Chapter II	Probe steel ball on insulating handle
342	-do-	Al Foil leaves on silk thread in container.
343	-do-	Insulated stands (pair)
344.	-do-	Straight conductor with insulated handle
345.	-do-	Suspension for plastic strip
346	Chapter III and IV	Glass tumbler-60-70 mm dia.
347	-do-	Neon bulb (small)
348.	-do-	Zinc plate
349	-do-	Copper plate
350.	-do-	Torch bulbs (2 5 V) -3 in container
351	-do-	Ammeter
352.	-do-	Voltmeter
353.	-do-	Board with wires of different resistance
354	-do-	Carbon electrodes (2)
355.	-do-	Copper sulphate in plastic container (50 ml.)
356.	-do-	Holders for torch bulbs (3.)
357.	-do-	Set of resistors, (5,10,10,20,) Ohm.
358	-do-	Rheostat, 50 Ohm
359.	-do-	Electromagnet with iron core
360	-do-	Spring for the core
361	Chapter V	Electric motor-cum-generator model
362.	-do-	Wooden block
363.	-do-	Heating effect of current model
364	-do-	Model of electric fuse holder
365.	-do-	Fuses (50 Pcs in container)
366.	Chapter VI	Iron dust in plastic container (20 gm)
367	-do-	Compass model
368	-do-	Magnetic needle (pair)
369.	-do-	Device for magnetic field of straight conductor
370.	-do-	Magnetic field of solenoid apparatus
371	-do-	Electric bell-cum-telegraph model
372.	-do-	Device for motion of conductor in magnetic field
373	-do-	Wire loop in a magnetic field
374.	-do-	Kit box

Examples of Improvisation

32. Smoke Box (*S. No. 310*)



Requirements

(i) A device to perform experiments on light and optics.
(ii) To operate on the rays of the Sun.
(iii) The size of the device to be enough for observation of experiments and suit the kit box.
(iv) Visibility of various phenomena.
(v) Easy operation.
(vi) To be sturdy.
(vii) To be inexpensive.

Availability in the market

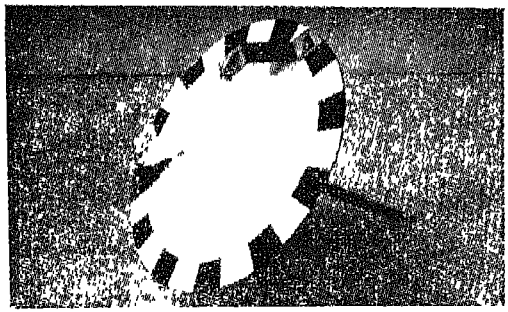
Such device is not available but instead the experiments are usually performed with the help of paper and pins.

Some devices are available but are very costly and also use other source of light which is not available in villages.

The Prototype

Wooden box of size 470 x 180 x 195 mm. height with round openings covered with glass on two sides to admit rays of light inside, has been designed which operates on Sun rays and provides visibility of the path of light with the help of smoke inside. This size permits its being kept inside the kit box. Lenses are mounted on a scale inside and also on the lid of the whole admitting Sun rays. There is a small device for keeping incense for making smoke. Intensity of smoke could be adjusted by moving out this device. Operation is simple and the device is sturdy and inexpensive.

33—Disc Holder (*S. No. 311*)



Requirements

(i) A device to mount glass prisms, rectangular slab, D-shaped slabs periscope, concave and convex mirrors inside the smoke box.
(ii) Easy replacements of these items mentioned above.
(iii) No obstruction to light in the above mentioned items while doing experiments.
(iv) Should rotate and be kept in any position.
(v) Angular graduations on the disc to show divergence of rays.
(vi) It should be easy to handle, sturdy and inexpensive.

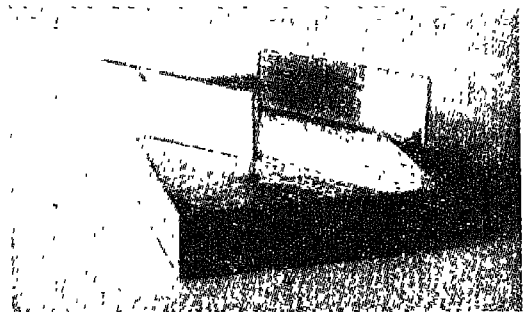
Availability in the market

Since this forms a part of accessories of smoke box, these are not available in the market.

The Prototype

The prototype satisfies the requirements A circular disc with painted thick angular graduations illustrates the divergence of rays. This disc mounted on a rod can be rotated and kept in any position. The fixtures for holding the various optical items have been designed not to obstruct the path of light rays. It is strong, easy to handle and inexpensive.

34—Periscope (*S. No. 318*)



Requirements

(i) A device to illustrate the principle of periscope.
(ii) An open model to provide visibility of the phenomena.
(iii) An appropriate size to be held on the disc holder of the smoke box.
(iv) Simple, sturdy and inexpensive.

Concept

Reflection of light.

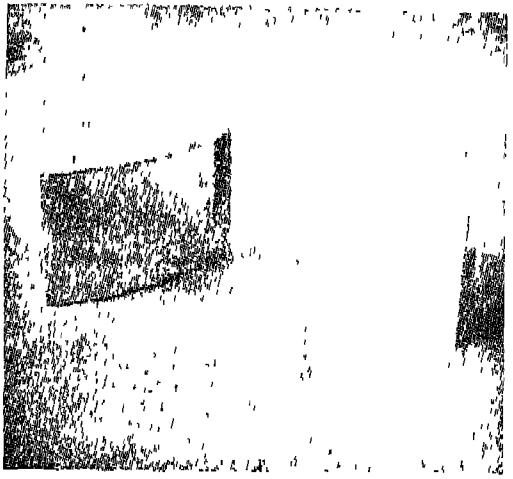
Availability

No such model available in the market.

The Prototype

The prototype satisfies all the require ments. Two small mirrors mounted on wooden block of normal thickness of a optical slab illustrate the phenomena o reflection of light as is used in a periscope The block is then mounted on the disc holde of the smoke box. Since the disc holde can rotate and be kept in any position, th light rays can be reflected in any number c angular positions. The device is sturdy, eas to handle and inexpensive.

35—Concave and Convex Mirrors
(S. No. 325)



Requirements

(i) Convex and concave mirrors to be mounted on the disc holder of the smoke box.

(ii) Unbreakable or lasting.

(iii) Simple, sturdy and inexpensive.

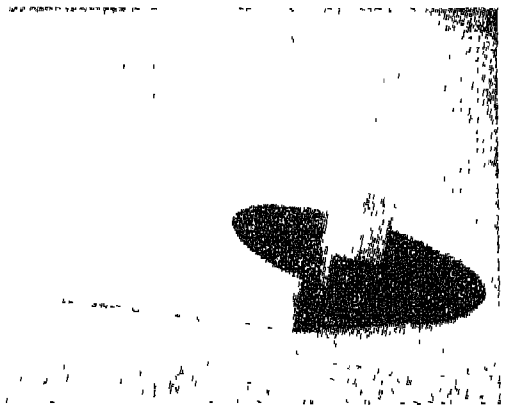
Availability

Conventional convex and concave glass mirrors available which are breakable and cannot be mounted on the disc holder.

The Prototype

The mirrors are made out of aluminium sheet of 2 mm. thickness and buffed to give them proper shine. These are unbreakable. These have been fixed on plastic pieces of thickness equal to the thickness of the glass slab, so that these can be mounted on the disc holder of the smoke box. The curvature of concave mirror is such that the focal point can be seen on the surface of the disc. It is sturdy, simple and inexpensive prototype.

36—ELECTROPHOROUS (*S. No. 334*)



Requirements

(i) A device to produce the static electricity charge.
(ii) It should not be dangerous to human body.
(iii) The discharging spark should be visible.
(iv) Easy to handle, inexpensive and durable.

Availability

Conventional apparatus available which is very expensive.

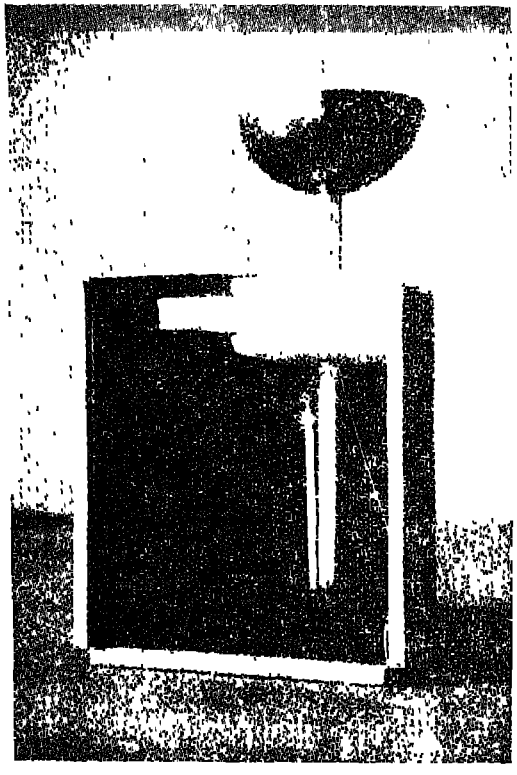
The Prototype

The prototype consists of a circular, painted M.S. sheet of diameter 200 mm. This disc has a handle in the centre which is covered by fixing thermocole rectangular block. There is a thermocole board of size 200 mm. × 200 mm. × 25 mm. height. A piece of woollen cloth is also provided.

The static charge is produced by rubbing the woollen piece on the thermocole board. It is transferred to the M S disc when it is placed on this board and just touched with finger, which should immediately be removed. The disc is then lifted. The charge gets accumulated on the disc. When the finger is then brought near the surface of the disc slowly, a spark can be seen and its crackle heard The spark is not dangerous but the intensity will depend upon the intensity of rubbing.

This is a very simple device and cuts the cost to a meagre amount as compared with conventional apparatus. It is sturdy and durable.

37. ELECTROSCOPES (PAIR) (*S No. 340*)



Requirements

(i) A device for transferring charges from charged body to uncharged body.

(ii) Also to indicate intensity of charge transferred.

(iii) The indicator of charge to be visible to teacher as well as to pupils.

(iv) To be highly sensitive.

(v) To indicate two different types of charges transferred through induction.

(vi) It should be easy to handle, inexpensive and durable.

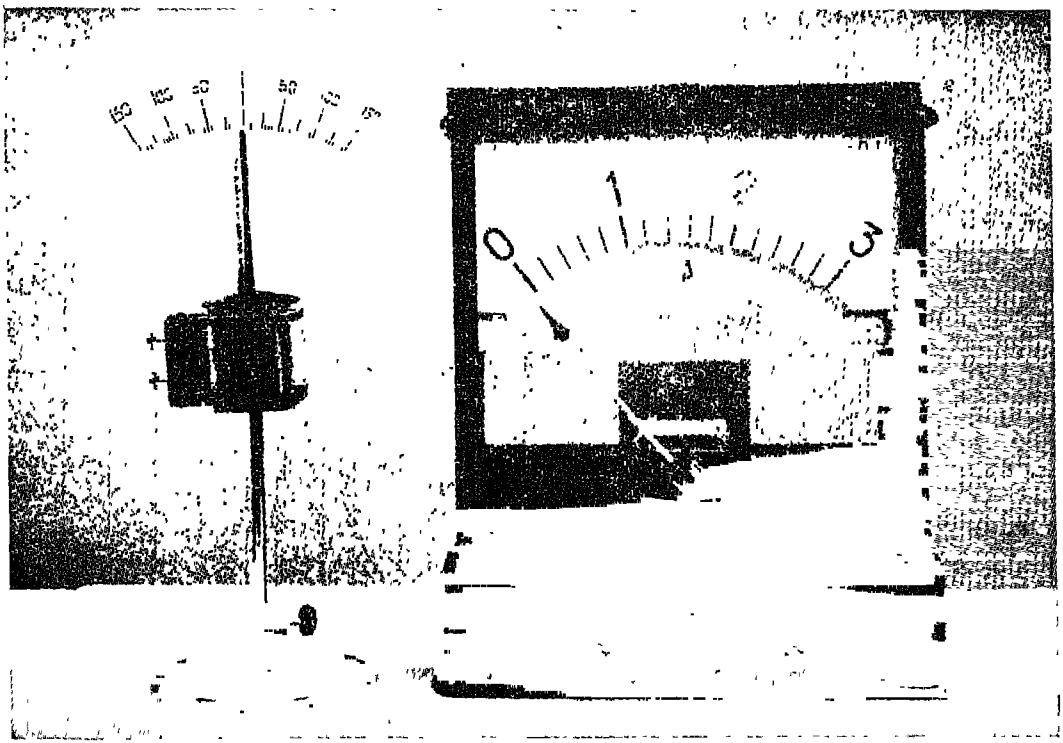
Availability

Conventional type of models available but expensive.

The Prototype

The prototype satisfies the requirements. It is sensitive and deflection of indicator can be easly watched by students at a distance of 6 metres. A window has been provided at the back so that the teacher can watch the indicator at the same time without obstructing the view of the students. This is located at the top of the back screen whose remaining part is painted with dark colour. Since the pointer is made out of the aluminium foil, this background gives a contrast and the movement of the pointer can be noticed easily. The insulation is made of the thermocole which is a perfect insulator for static electricity and is inexpensive. A cup-shaped bowl is provided at the top to increase the surface area receiving the charge. If two such electroscopes are connected by a wire at the bowls, different types of charges can be induced in each of the electroscopes when a charged body is brought near one of them or touches one. The probe metallic ball is used for transferring charge from one electroscope to another. It is a simple device, inexpensive and durable.

38. AMMETER (*S. No. 351*)



Requirements

(i) A device to measure current from dry battery cells.

(ii) To be an open model to demonstrate the principle of its working.

(iii) To be sensitive to verify Ohm's Law

(iv) Detachable to show the construction.

(v) Easy to handle, inexpensive and durable.

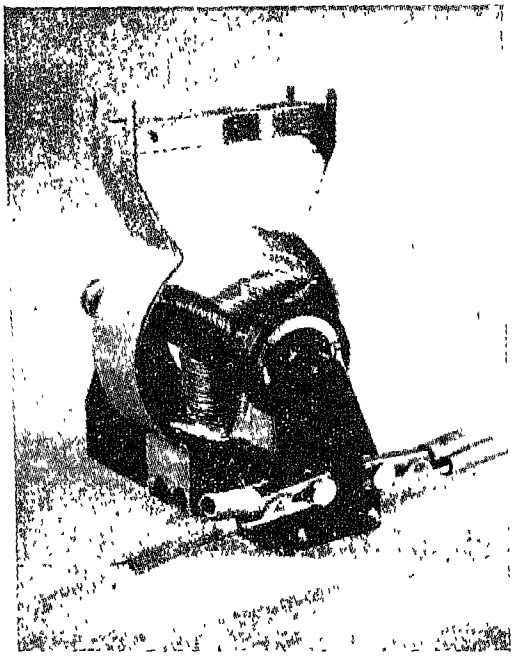
Availability

Conventional type closed model is available. It is expensive and also does not fulfil above requirements.

The Prototype

The prototype consists of a plastic base. support for permanent ring magent and the plastic pointer, made out of brass and the detachable coil with aluminium wire. This is quite sensitive and can be operated even on a single dry battery cell. With the help of a similar voltmeter, Ohm's Law can be verified. A scale is provided with divisions for reading the current. It is easy to handle, inexpensive and durable.

39. Model Of Electric Motor-cum-Generator (*S No. 361*)



Requirements

(i) A device to show the principle of working of the electric motor and of generator.
(ii) To be an open model to demonstrate its working.
(iii) To operate on dry battery cells
(iv) Easy to start with battery cells without any other efforts.
(v) Use of permanent magnets or electromagnets can be demonstrated.
(vi) Easy to handle, inexpensive and sturdy.

Availability

Such models are not available.

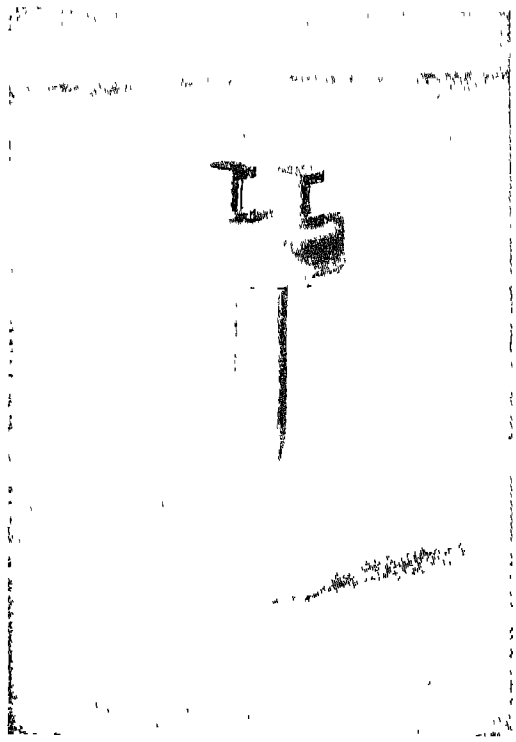
The Prototype

The prototype satisfies the requirements. Its plastic base supports 3 pole armature mounted on a shaft. On its sides are fixed two iron strips of a particular shape which substitute for the casing, On the top of these strips either permanent magnet or a core with coil can be held. The armature is wound with aluminium wire to reduce the cost.

To work the model as a generator, a piece of string is wound on the pulley fixed on one side of the shaft (the terminals are connected with ammeter or voltmeter) and then the string is pulled with a jerk. The deflection of pointer will indicate the generation of the current.

The prototype is very simple and can be fixed on the laboratory stand. It is inexpensive and durable.

40. Heating Effect Of Current Model (Battery Operated) (*S. No 363*)



Requirements

(i) A device to make heating effect of current visible and to show burning of paper.
(ii) To operate on dry battery cells.
(iii) To be visible from a distance of 6 metres.
(iv) Protected from wind
(v) Simple, inexpensive and durable.

Availability

No such device, fulfilling the above requirements available

The Prototype

It satisfies the requirements. Coiled nichrome wire is fixed on the two copper wire supports. Each of these supports has a terminal at its end. This is placed in a plastic container with lid It can be operated by three cells The nichrome wire is heated and it glows. It is taken out and piece of paper can be burnt. Spare nichrome wires have been provided for replacement, if required. It is easy to handle, inexpensive and will last long if used with care.

41. Model of Electric Fuse Holder with Fuse (Battery Operated) (*S No 364 and 365*)

Requirements

(i) A device to demonstrate the use of fuse in a circuit

(ii) To operate on dry battery cells.

(iii) Easy replacement of fuse

(iv) Visibility of action taking place.

(v) Easy to handle, inexpensive and sturdy

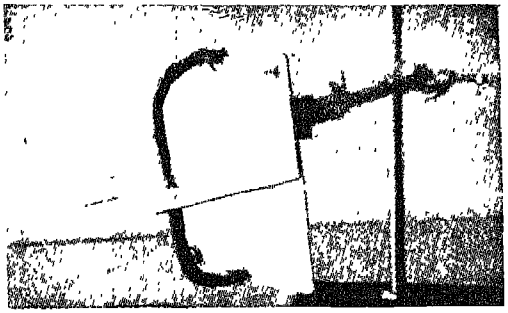
Availability

No such device operating on battery cells available.

The Prototype

It consists of a plastic holder on which are fixed two crocodile clips. The fuse wire is fixed on a small piece which can be held between the two crocodile clips. The frame has two terminals which are connected to each of the crocodile clips When the terminals which are connected to a battery cell operated circuit, the fuse will blow in case it is short circuited. At the time of blowing, the paper fixed to the fuse wire will start burning. When the paper stops burning, it is an indication that the fuse has blown off. Paper is attached to the fuse wire to prolong the demonstration, otherwise the fuse will burn instantaneously and the pupil will fail to observe the phenomena.

42. Device for Magnetic Field of Straight Conductor (*S No 369*)



Requirements

(i) A device to demonstrate the magnetic field created by a straight conductor.
(ii) To operate on dry battery cells.
(iii) To be easy to hadle, inexpensive and sturdy.

Availability

Such model is not available.

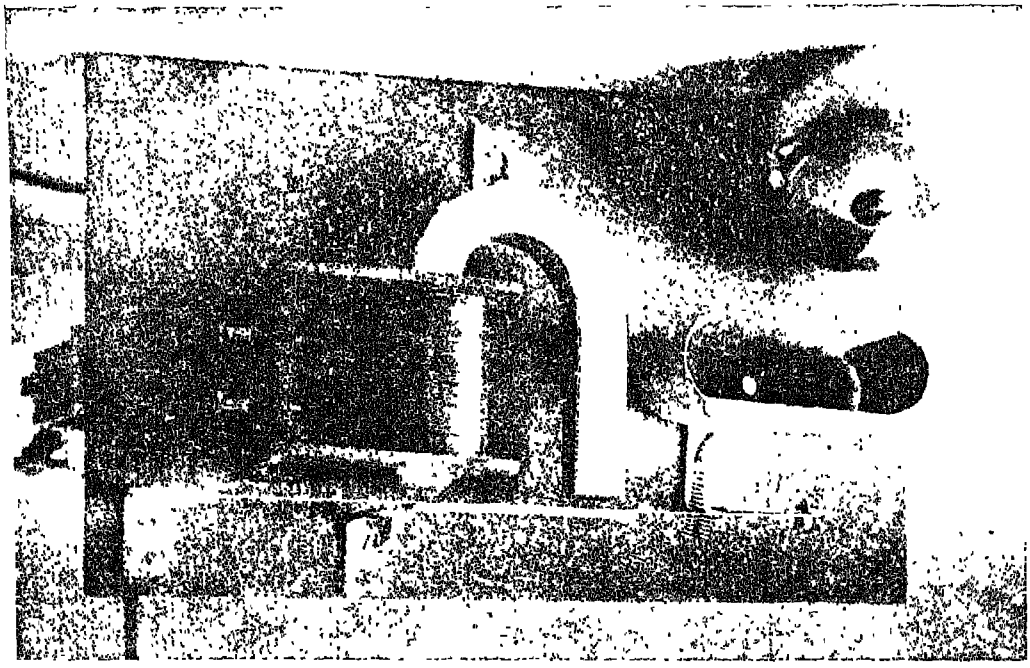
The Prototype

The prototype consists of two painted aluminium bases fixed at right angles. An aluminium coil properly insulated is wrapped round the bases to serve as the straight conductor. Since one single conductor operated on battery would have produced very weak magnetic field, we have provided a number of straight conductors which represent the coil. The front part of the coil will look like a straight conductor and the portion at the back will be concealed behind the vertical base.

The device is fixed on a laboratory stand by holding either the back portion of the coil or the lower portion of the vertical base by a clamp The iron dust is then spread out equally round the straight conductor on the horizontal base. The two terminals of the device are then connected to the dry battery cell holder To get a clear picture of the magnetic field the horizontal plane is gently tapped for 5-10 seconds by a pencil or even with a finger.

The prototype satisfies the requirements. It is easy to handle, inexpensive and durable.

43. Electric Bell-cum-Telegraph Model (*S. No. 371*)



Requirements

(i) A device to show the principle of electric bell and telegraph apparatus.
(ii) To operate on dry battery cells.
(iii) Visibility of action.
(iv) Easy conversion of electric bell into the telegraph apparatus and *vice-versa.*
(v) Simple in operation, inexpensive and durable.

Availability

Models available are not convertible.

The Prototype

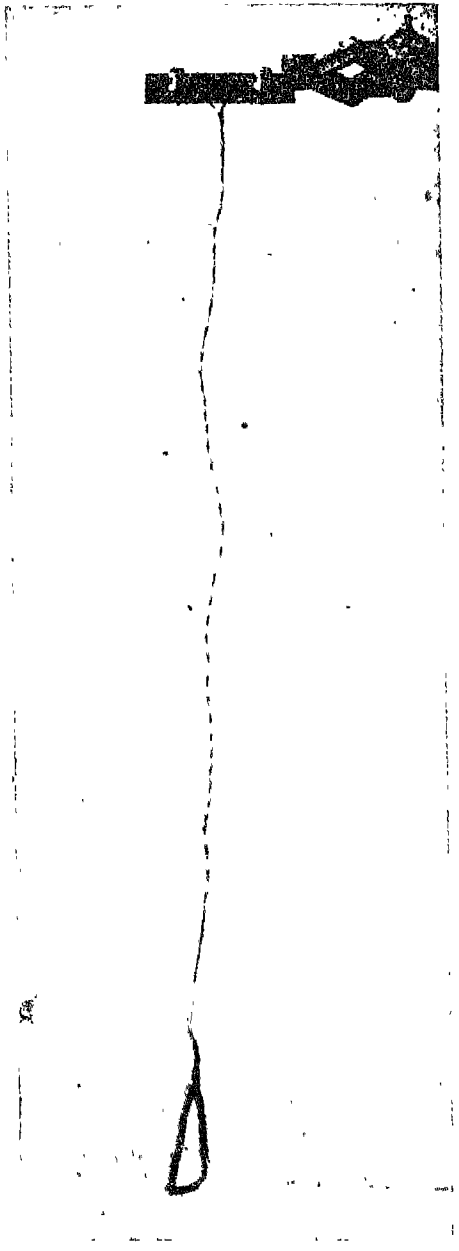
The device fixed on a wooden board has a coil mounted on a U-shaped iron core. This coil is also used in other items to cut the cost. The bell or telegraph apparatus can be fixed to the wooden board easily. A spring steel strip carrying a mild steel plate and a striker at the free end is fixed on the other end. There is a gap between the tips of the U-shaped iron core and the strip which is adjustable by means of a screw type terminal.

For showing the bell action, the circuit is completed by connecting one end of the battery holder to one terminal of the coil. The other terminal of the coil is connected to the screw type terminal which should touch the strip The other end of the battery holder is then connected to the strip. The action will then start.

To convert it into the telegraph apparatus, only the bell cap is replaced by the support for paper strip. A device for making impressions in ink on the paper tape is also

fixed The circuit in this case is completed by connecting one terminal of the coil to the battery holder and other terminal of the coil is connected and disconnected by the teacher to the other end of the battery holder. At the same time the paper tape is moved by the student. This will reproduce the telegraph code on the paper.

44. Device for Motion of Conductor in a Magnetic Field (*S. No. 372*).



Requirements

(i) A device to demonstrate the motion of conductor in magnetic field.
(ii) To operate on dry battery cells.
(iii) Easy to handle, inexpensive and durable.

Availability

No such model available.

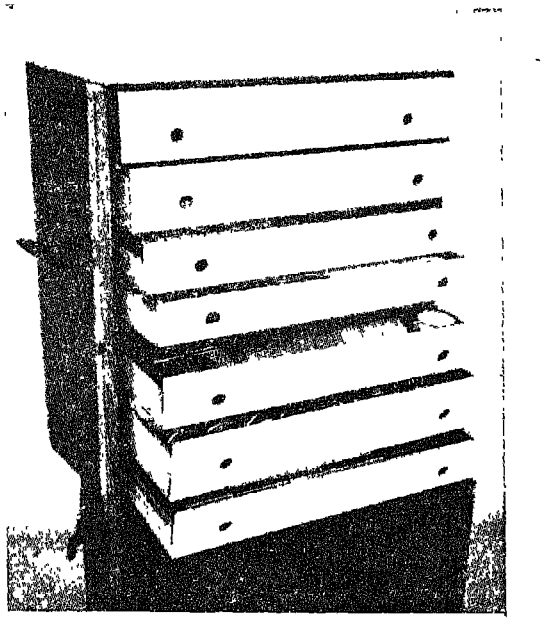
The Prototype

Since a single conductor will produce a weak magnetic field in a dry cell battery operated circuit, a number of copper conductors have been provided in the triangular shaped coil. The lower portion will serve as a conductor. The coil is connected with two half metre long flexible wires connected to the terminals on the hard board base at the top. The base is fixed on the laboratory clamp. The coil is suspended in between two magnets.

When the terminals are connected to the dry battery cell holder, the motion of the conductor is observed. If the poles of a magnet or the direction of the current are changed, the motion will be observed in the opposite direction.

PHYSICS PUPIL'S KIT NO. III

D.S E. (C S.W X)



This Kit has been designed as a supplement to the Physics Demonstration Kit No. III. It contains sufficient material to enable a class of 45 students to perform their own experiments in batches of three each.

A special kit box made of wood contains seven drawers. Fifteen sets of 39 items in varying quantities are kept in the drawers. The box measures 480 mm. × 257 mm. × 630 mm. height There is no problem of storage as this kit may be kept in a corner of a room. These items have been listed tray-wise so that the students can themselves replace these items after performing experiments.

Although most of the items correspond to those of the Physics Demonstration Kit No. III, a few are really the simplified models or pupil's version This cuts the cost and the handling becomes easier Two such examples of improvisation are given in the following pages.

A list of items has been given It may be seen that a number of these are available in the market

LIST OF ITEMS

Sl No	Name of the item	Qty
	TRAY NO. 1	
1.	Holder for the cells	1x15
2	Dry cells	3x15
3	Support for the glass sheet	1x15
	TRAY NO. 2	
4.	Improvised photometer	1x15
5.	Glass sheet, square, 100 mm. x 100 mm. x 3 mm.	1x15
6.	Convex lens mounted on a stand 80 mm focal length, 40 mm. diameter	1x15
7	Screen, out of tin sheet, supported, 100 x 100 mm. painted white	1x15
8.	Plastic strip chargeable negatively with a small hole in the middle above the centre	1x15
9	Similar chargeable positively, 100 x 25 x 25 mm.	1x15
10.	Similar, with a piece of cloth attached	1x15
11.	Piece of cloth for rubbing 50 x 100 mm.	1x15
12	Light foil strip on a silk thread	1x15
13	Silk thread	One roll
14.	Support for Photometer	1 x 15
	TRAY NO 3	
15	Plane mirror, 30 x 80 mm on a wooden slab 30 x 80 x 20 mm.	1x15
16	Glass Slab, 40 x 60 x 15 mm.	1x15
17.	Simple electroscope (mounted in a glass bottle)	1x15
18	Carbon electrodes with holder	2x15
19	Plastic tumbler	1x15
	TRAY NO 4	
20	Candles small size 100 mm.	2x15
21.	Torch bulb on a support, 2·5 V, 45 mm height	1x15
22.	Copper sulphate	1 pack (250 gms)
23.	Permanent bar magnets	1 pair x 15
24.	Iron dust in a container	1 container x 15
25	Magnetic needles, 40-50 mm length	2x15
26.	Support for magetic needle	2x15
27.	Coil, 220 turns, 40 mm. length, 5 mm. inner dia.	2x15
28.	Iron core for the above coils, 70 mm. length	1x15
	TRAY NO. 5	
29	Paper pins, steel, 30 mm. long	1 packet
30	Connecting wires	6x15
31	Heating wire in a holder	1x15
	TRAY NO. 6	
32	Ammeter, simplified model	1x15
33.	Connector (improvised key)	1x15
34.	Resistors, 5 Ohm and 10 Ohm	1 set x 15
	TRAY NO. 7	
35.	Scale, (students) aluminium, 30 cm length	1x15
36.	Protractor, (students)	1x15
37	Hardboard sheet, 20 x 230 mm	1x15
38	Piece of high resistance wire (200 mm. length)	1x15
39	Cello tape	One roll
40	Kit Box	1

Examples of Improvisation

45. Simple Electroscope (Pupil's)

Requirements

(i) A device to indicate different charges.
(ii) Size to be small.
(iii) To be sensitive.
(iv) Inexpensive.
(v) To be easy to handle and sturdy.

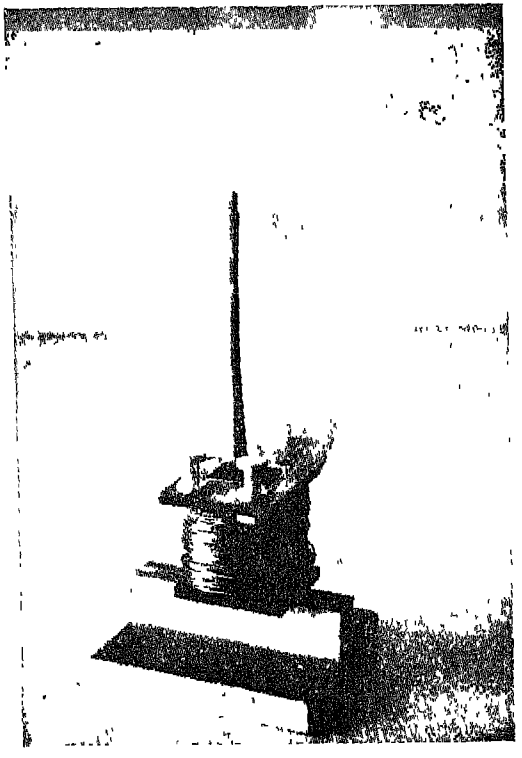
Availability

No such device available.

The Prototype

It consists of a small cylindrical glass container and a thermocole cork with a steel rod having aluminium foil fixed to it with a cotton thread. The cork is fitted to the glass container. Positive and negative charges can be induced to the aluminum foil by bringing a charged body near the top end of the steel rod or by touching. The aluminium foil will repel and indicate the presence of the charge. The intensity of repulsion will depend upon the intensity of the charge In this state, if the opposite charge is brought near the top end of the steel rod or touched, the aluminium foil will return to its original position. The cost is almost negligible and the device is sensitive and sturdy.

46. Ammeter (Pupil's)



Requirements

(i) A device to measure current in pupil's experiment.

(ii) To operate on dry battery cells

(iii) To be sensitive.

(iv) Easy to handle, inexpensive and sturdy.

Availability

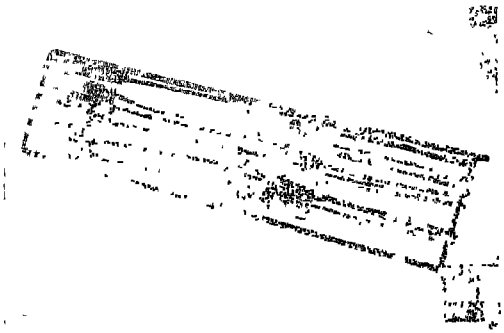
No such device available.

The Prototype

The prototype consists of a wooden base (which is used in optics experiments also) and a U-shaped brass support for a detachable coil and a plastic needle mounted on ring magnet. The coil is then connected in an electrical circuit The plastic needle will immediately deflect. More the current, more the deflection. A scale is provided with divisions for reading the current.

The device is simple, inexpensive and sturdy.

47 Frame for Keeping Connecting Wires



Requirements

(i) A device to store six connecting wires.

(ii) Convenient to handle in taking out wires and placing them back.

(iii) Simple, inexpensive and durable.

The Prototype

A frame is made out of M.S. wire 3 mm. thick. One end of the connecting wires with crocodile clips can be fixed on one side of the frame The wire is then wrapped round the other side and fixed in middle of the frame. It is convenient to handle and can be stored in the kit box easily. It is inexpensive and durable

7. Scope for Further Improvements

THERE was age-old belief that science could be taught only by means of sophisticated apparatus Lack of this apparatus and the cost involved proved to be a deterrent in introducing science in all the stages of school education. Further, it was felt that for a proper approach to science teaching there should be separate laboratory in each school. This was beyond the reach of the village schools where even the optimum space for classes is not available and due to the large number of such schools, the State Governments also find it difficult to provide additional facilities Moreover, handling of the conventional apparatus required scientific background of the teacher. In a primary school, teachers are generally without such background and even in middle school, they are not adequately oriented. To replace such a huge number of teachers or to provide additional science teachers in every school could not be considered feasible.

These prototypes thus fill a vacuum and motivate educational planners and administrators to introduce science teaching at school level. The apparatus is inexpensive and has been designed keeping in view the limitations of a remote single teacher village school It is simple and its use is fully explained so that teacher/pupil can use with confidence. Parts are easily replacable and the operation of items is not dependent upon the availability of gas, electricity or tap water. Lot of efforts have gone into the production of teacher guides and textbooks to enable even a non-science teacher to explain various phenomena to the students.

These prototypes, therefore, fulfil a great need and have brought a revolution in science teaching at school level. The process of development and improvement is continuous and we do not claim our prototypes to be perfect. Even in our workshop, the final prototype was different from the first one Efforts are still being made to use better material, evolve simpler designs and at the same time cut down the cost.

We hope that the institutions already involved in research, developments and production of scientific apparatus will give us the benefit of their experience in improvement of the designs of these prototypes. At the same time, we have no objection to the private manufacturers taking up mass-production of these kits, provided the quality and price are maintained at proper level.